احياء مجهرية طبية

قسم تقنيات البصريات

المرحلة الأولى

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Mycology

Classification & General Properties of Fungi

Disease of Yeast & Mold

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Mycology

- myco = fungus
- -logy = study

Definitions

- **Mycologists**--scientists who study **fungi**
- **Mycology**--Study of fungi.
  scientific discipline dealing with fungi
- **Mycoses**--diseases caused by fungi
- **Medical Mycology--- is the study of mycoses of man and their etiologic agents**

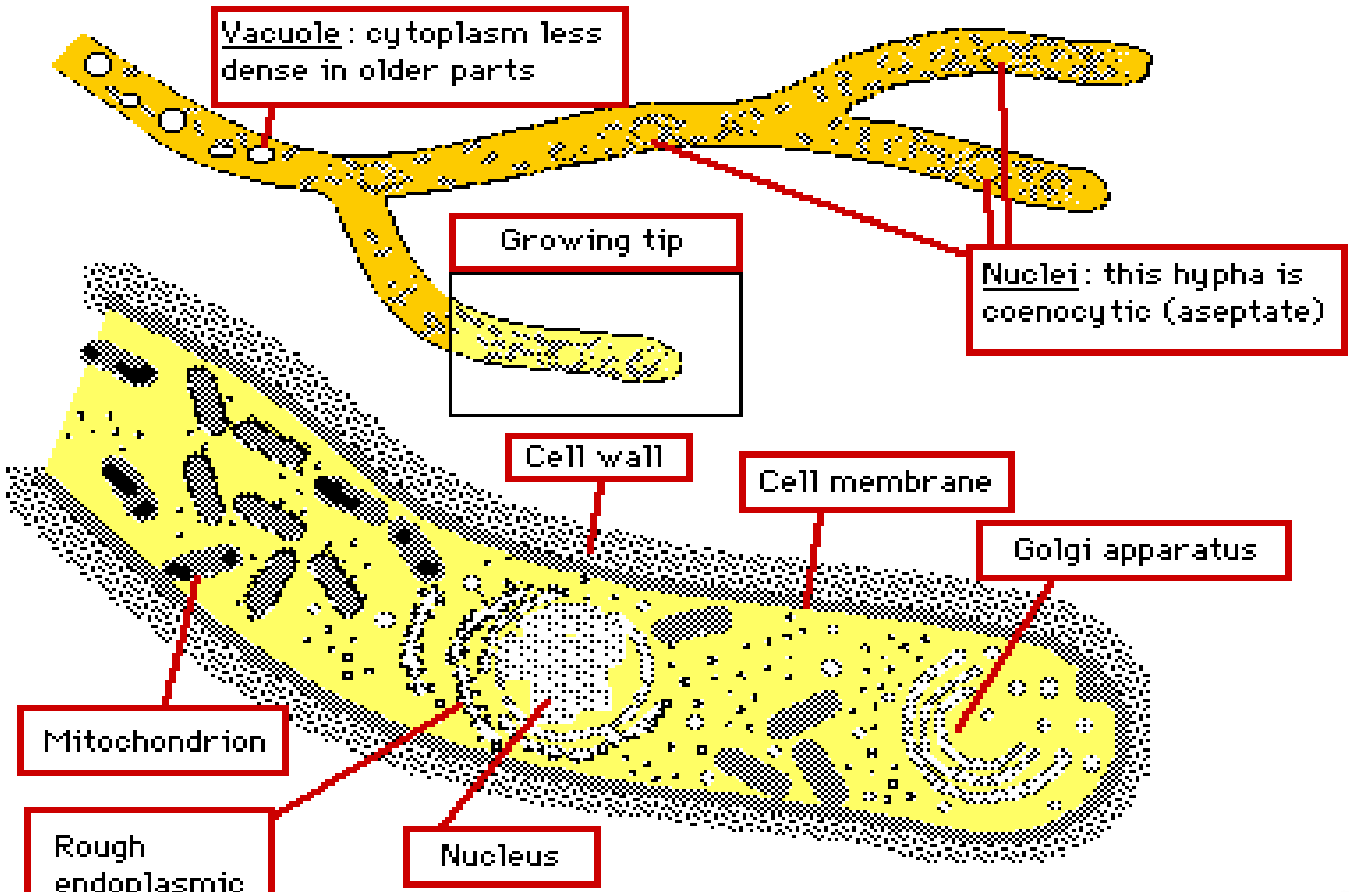
Introduction

- ***Mykes*** (Greek word) : Mushroom
- Fungi are eukaryotic protista; differ from bacteria and other prokaryotes.
  1. Cell walls containing chitin (rigidity & support), mannan & other polysaccharides
  2. Cytoplasmic membrane contains ergosterols.
  3. Possess true nuclei with nuclear membrane & paired chromosomes.
  4. Divide asexually, sexually or by both
  5. Unicellular or multicellular

Fungi differ from bacteria in the following points:-

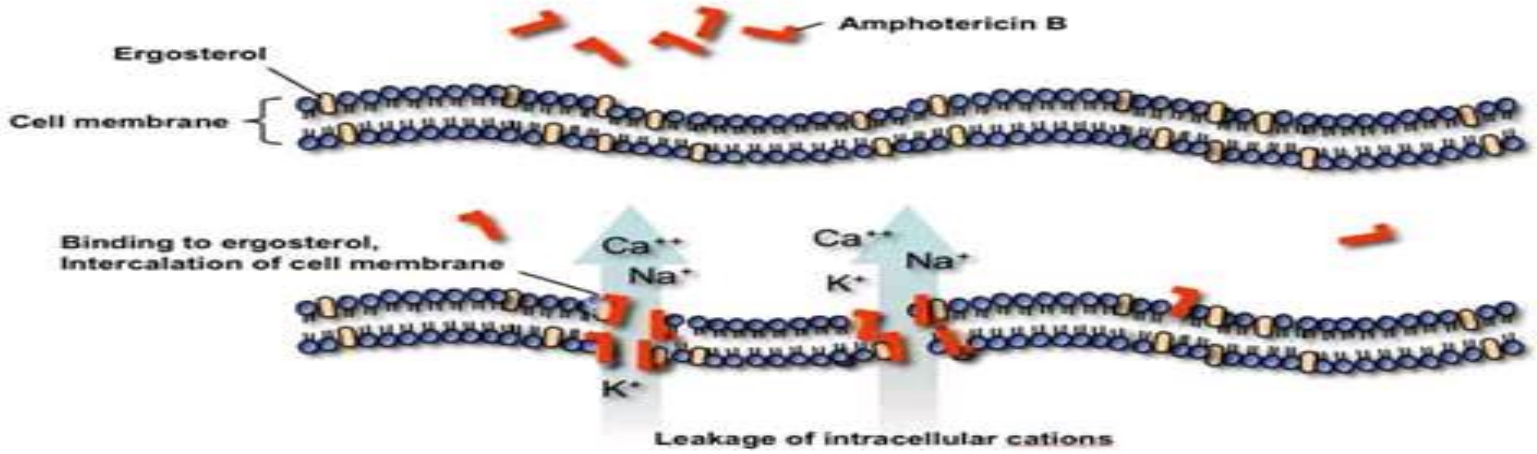
	Prokaryote (Bacteri)	Eukaryotes (Fungi)
Diameters	1 micron	4-15microns
nuclear membrane	No nuclear membrane	Nuclear membrane
Chromosomes	Single chromosome	multiple
Division	Binary fission	Mitotic division
cytoplasme	No organelles	Organelles
Cell wall	Peptidoglycan	Chitin
Cell membrane	No ergosterol	Ergosterol
Ribosome	70 S	80 S

FUNGAL CELL STRUCTURE



Fungal cell membrane

- Consist of ergosterol rather than cholesterol like bacterial cell membrane.
- **Ergosterol *is the site of action of antifungal drugs, amphtericin B & azole group***

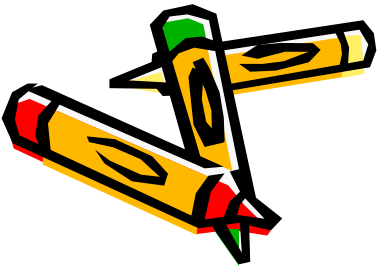


Introduction

- Chemoheterotrophs
  - Require organic compounds for carbon and energy
- Food industry: bread, alcohol, edible fungi (mushrooms), cheeses
- Some are deadly
- Adapted to environments hostile to bacteria
  - pH 5
  - High osmotic pressure
  - Low moisture
  - Complex carbohydrates (ex. Lignin from wood)
  - Less nitrogen

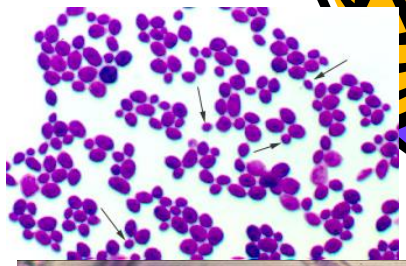
Introduction

- Most fungi are obligatory aerobes, some are facultative anaerobes, but none are obligatory anaerobes.

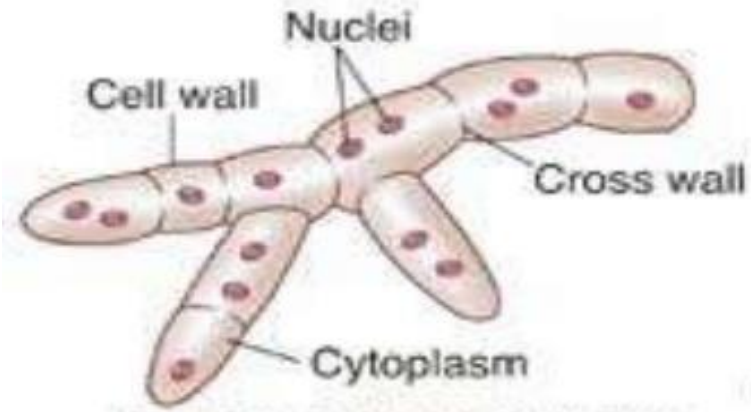


Introduction

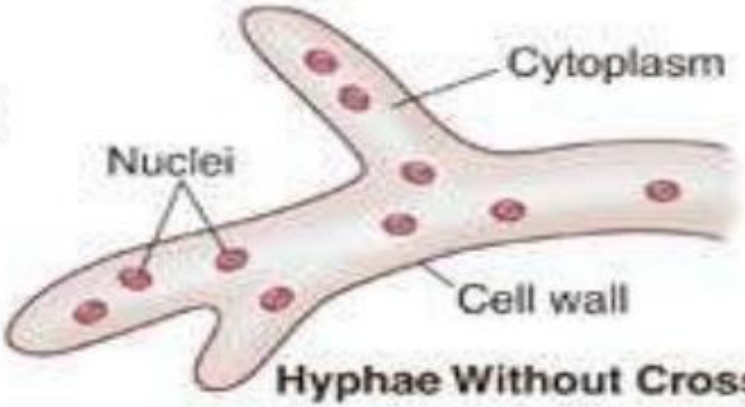
- Simplest fungus :- Unicellular budding yeast
- Hypha :- Elongation of apical cell produces a tubular, thread like structure called hypha
- Mycelium :- Tangled mass of hyphae is called mycelium. Fungi producing mycelia are called molds or filamentous fungi.
- Hyphae may be septate or non-septate



Structure and Function of Fungi



Hyphae With Cross Walls

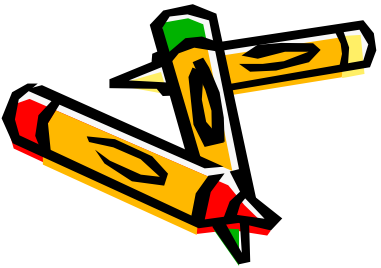


Hyphae Without Cross Walls

the vegetative part of a fungus, consisting of a network of fine white filaments (hyphae).

Mycology

- How do we identify molds in the lab?
  - Based on type of hyphae (septate versus non-septate)
  - Based on color of mycelium
  - Based on reproductive structures
    - Molds may form either sexual or asexual spores
      - Sexual spores are formed from the fusion of nuclei from two opposite mating strains of the same species. They are only formed under special conditions, but they are used to classify fungi (more on this later)
      - Asexual spores, which are most commonly used in identification, are formed by the aerial mycelium of a single organism by mitosis and cell division

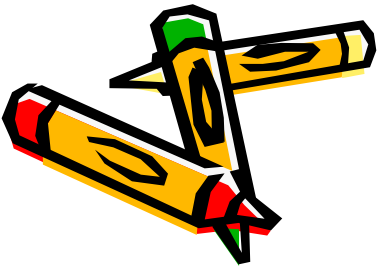


CLASSIFICATION

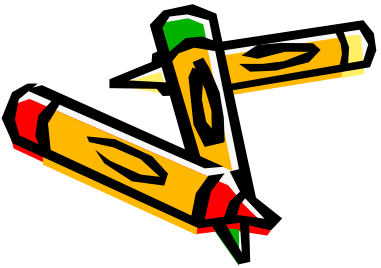
Morphological

Systematic

Clinical



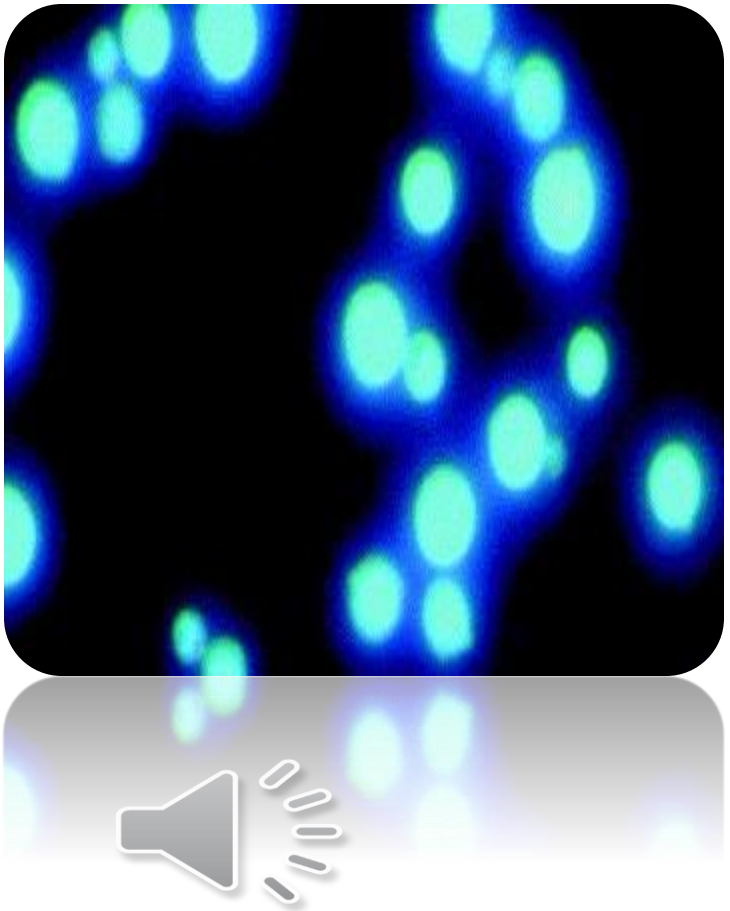
Morphological
Classification



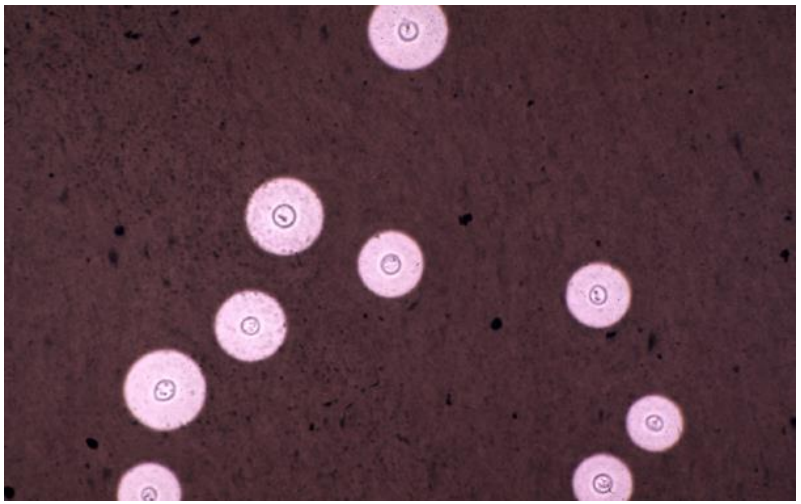
CLASSIFICATION

- Depending on **cell morphology**

1. Yeasts
2. Yeast like fungi
3. Molds
4. Dimorphic fungi



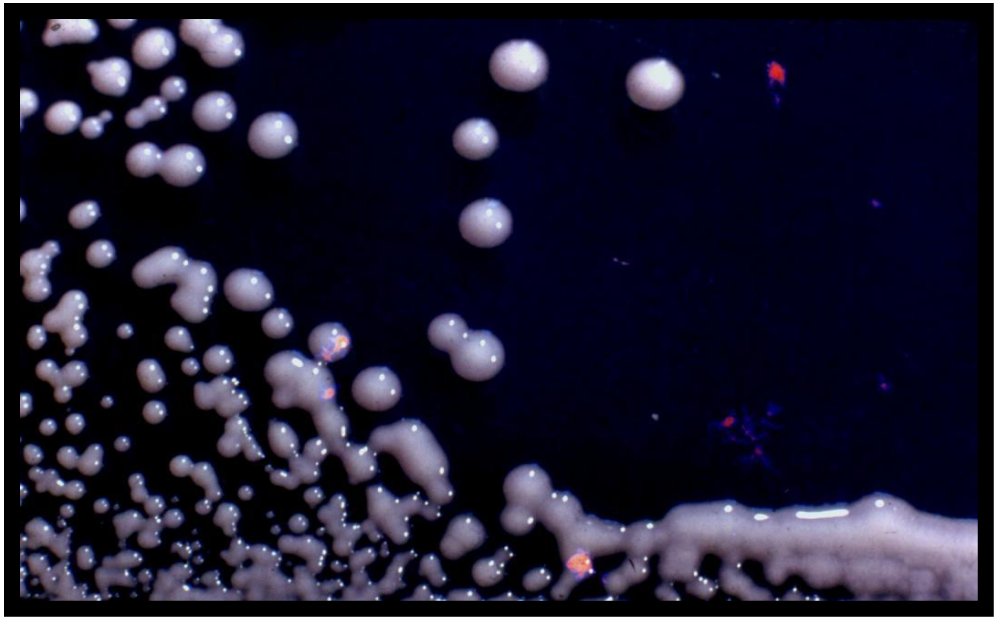
1. Yeasts



- Unicellular fungi which reproduce by budding
- On culture - produce smooth, creamy colonies

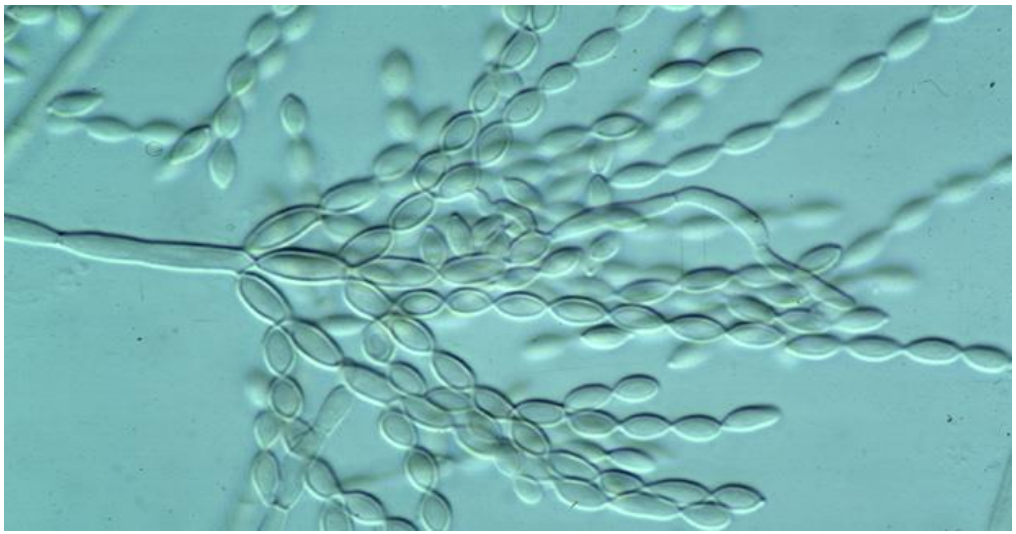
  e. g Cryptococcus neoformans (capsulated yeast)

Yeast colonies



2. Yeast like fungi

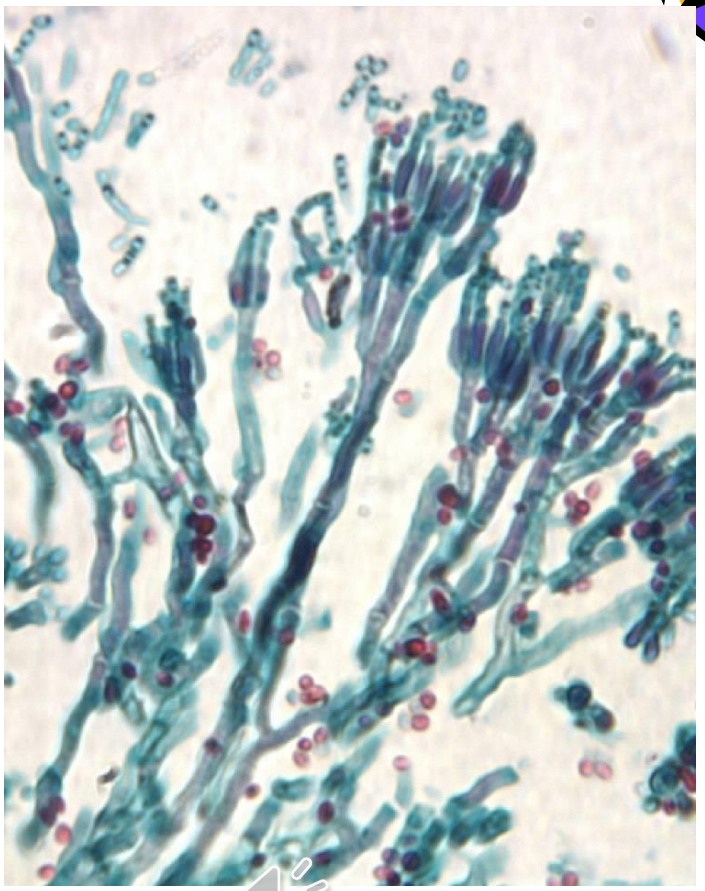
- Grow partly as yeasts and partly as elongated cells resembling hyphae which are called **pseudo hyphae.**
  e.g. Candida albicans



3.Molds/ Filamentous fungi

- Form true mycelia & reproduce by formation of different types of spores.
- Vegetative/ aerial hyphae

  e.g. Rhizopus, Mucor



4. Dimorphic fungi

- Occur in 2 forms
  - Molds (Filaments) – 25°C (soil)
  - Yeasts – 37°C (in host tissue)

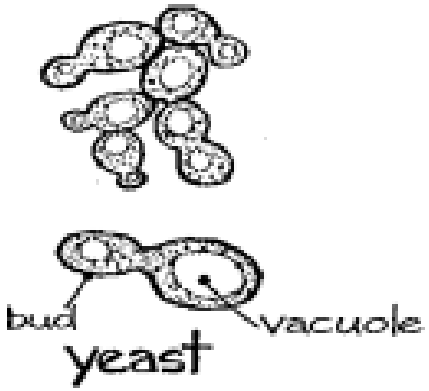
Most fungi causing systemic infections are dimorphic:

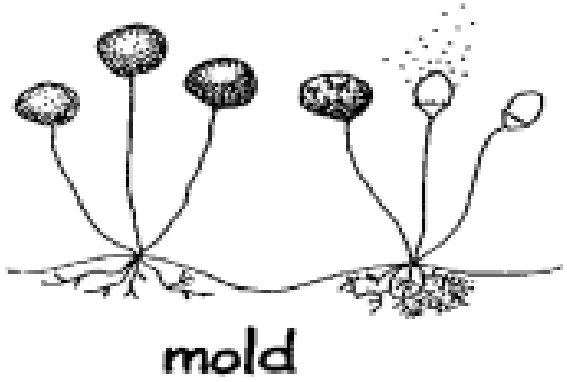
- *Histoplasma capsulatum*
- *Blastomyces dermatidis*
- *Paracoccidioides brasiliensis*
- *Coccidioides immitis*
- *Penicillium marneffei*
- *Sporothrix schenkii*

Morphological groups of Fungi

1. The **single-celled** fungi are **yeasts**

2. The **multicellular** fungi are **molds**





3. Dimorphism

– Grow as molds ***in vitro*** on artificial culture medium, but as yeasts ***in vivo*** in infected tissue.

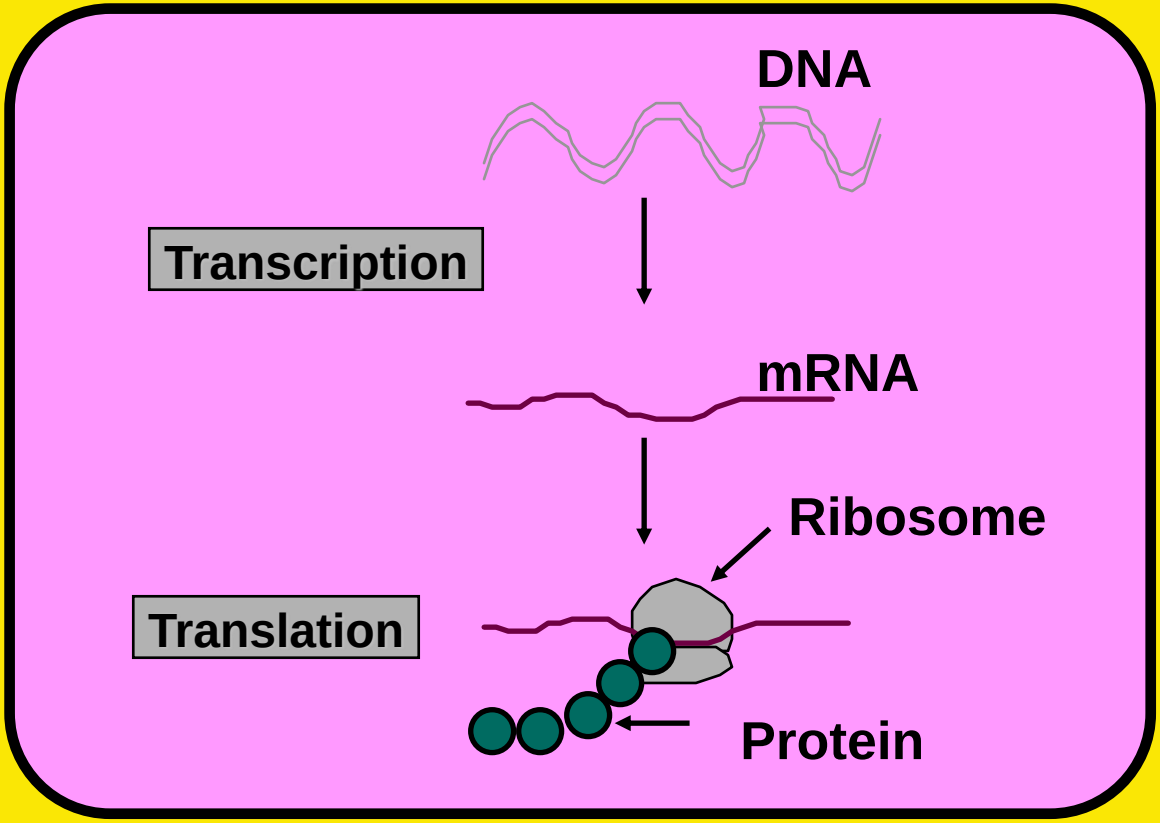
THANK YOU

PROTEIN SYNTHESIS

Protein Synthesis

- The production (synthesis) of polypeptide chains (proteins)
- Two phases: Transcription & Translation
- mRNA must be processed before it leaves the nucleus of eukaryotic cells

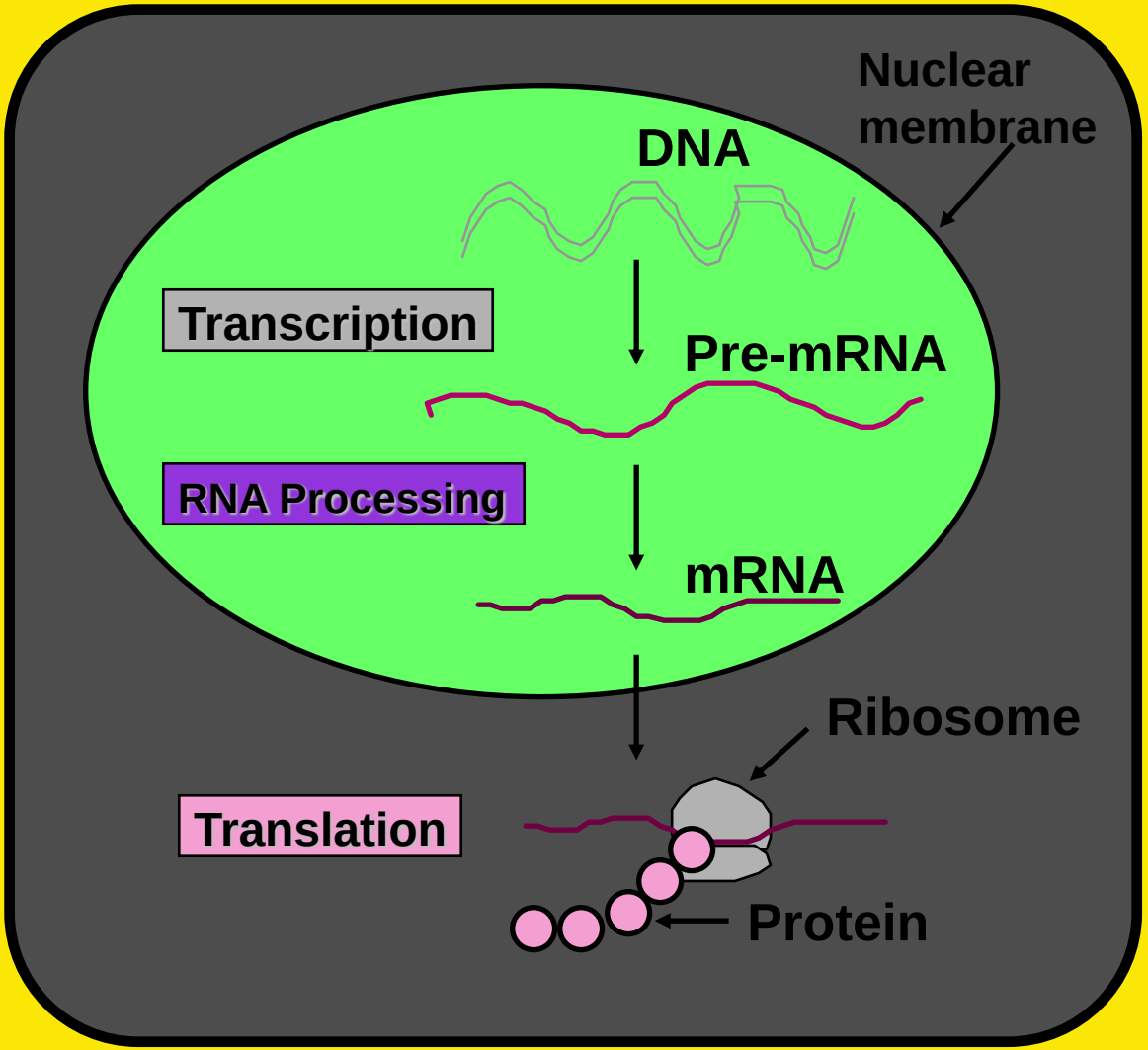
DNA → RNA → Protein



Prokaryotic Cell

DNA → RNA → Protein

Eukaryotic Cell



Pathway to Making a Protein

DNA

↓

mRNA

↓

tRNA (ribosomes)

↓

Protein

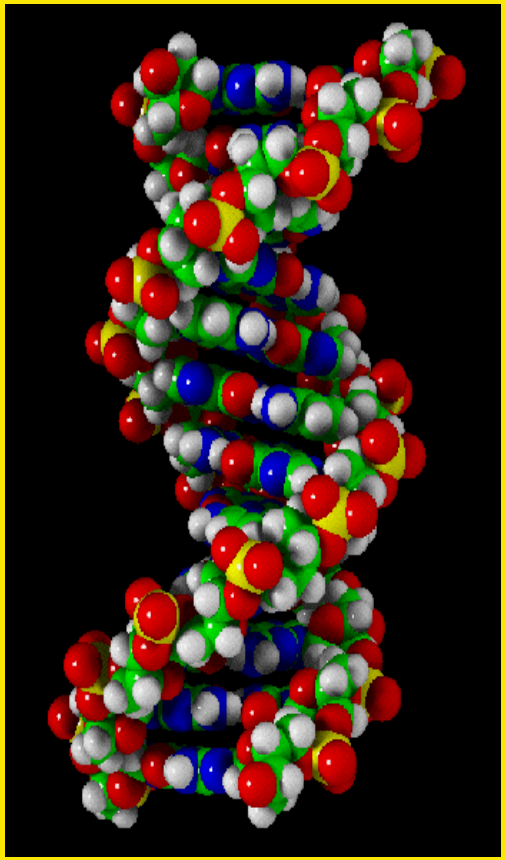
Nucleic Acids

DNA or Protein?

- Walter Sutton discovered chromosomes were made of DNA and Protein
- However, scientists were NOT sure which one (protein or DNA) was the actual genetic material of the cell

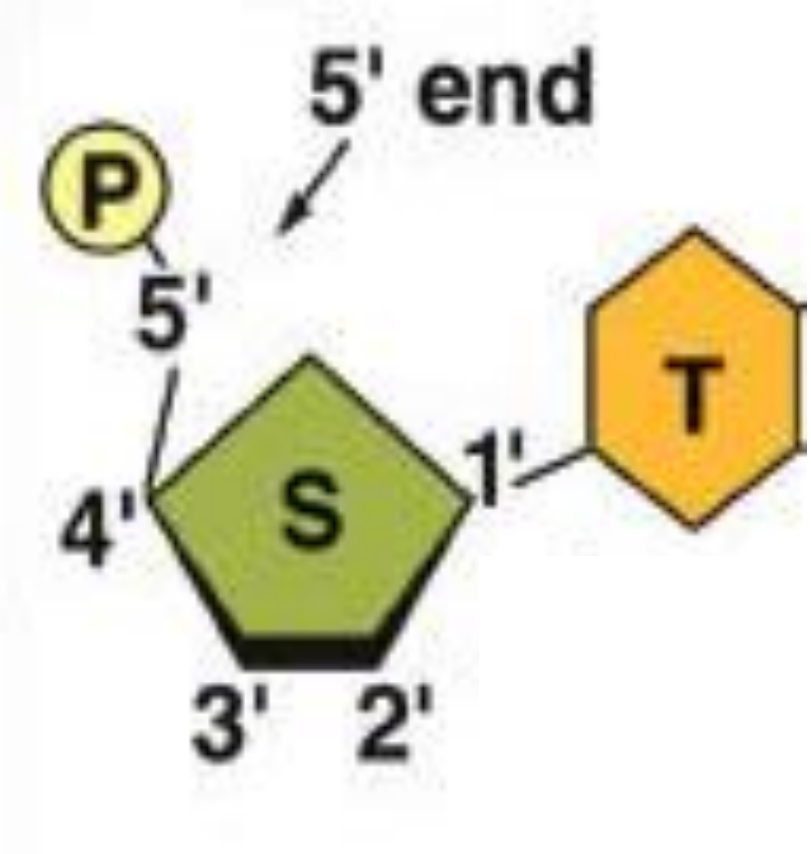
DNA!

- Frederick Griffith in 1928 showed the DNA was the cell's genetic material
- Watson & Crick in the 1950's built the 1st model of DNA



Structure of DNA

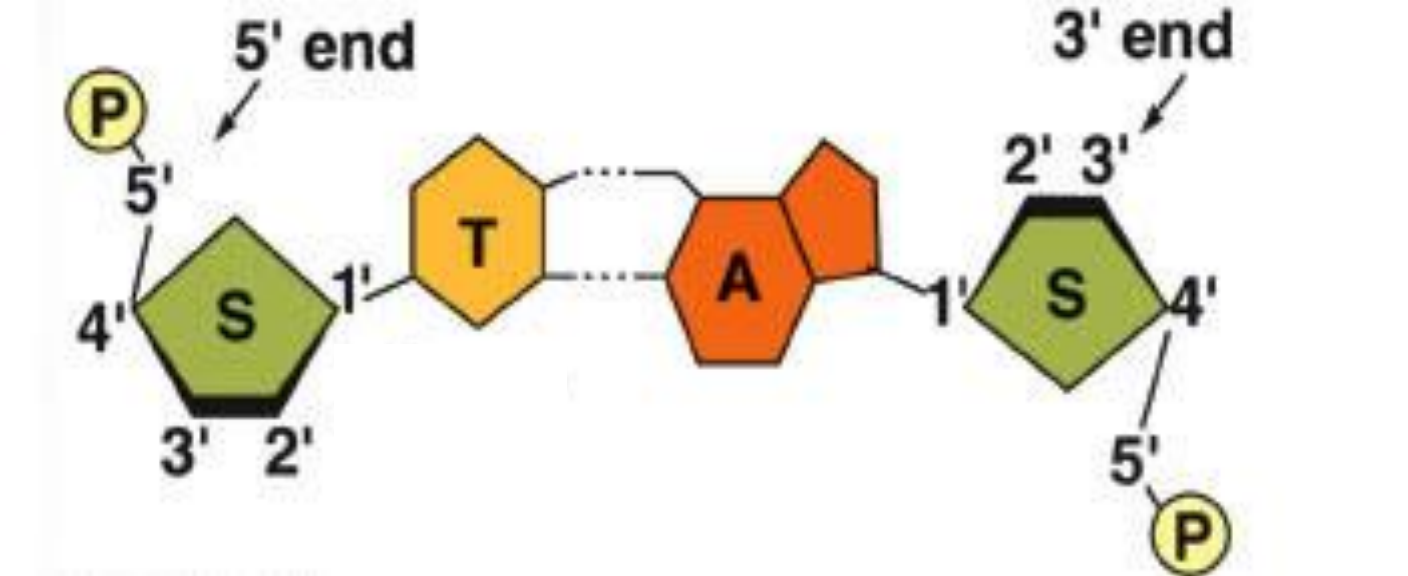
- DNA is made of subunits called nucleotides
- DNA nucleotides are composed of a phosphate, deoxyribose sugar, and a nitrogen-containing base
- The 4 bases in DNA are: adenine (A), thymine (T), guanine (G), and cytosine (C)



DNA Nucleotide

Base Pairing Rule

- Watson and Crick showed that DNA is a *double helix*
- *A* (adenine) pairs with *T* (thymine)
- *C* (cytosine) pairs with *G* (guanine)



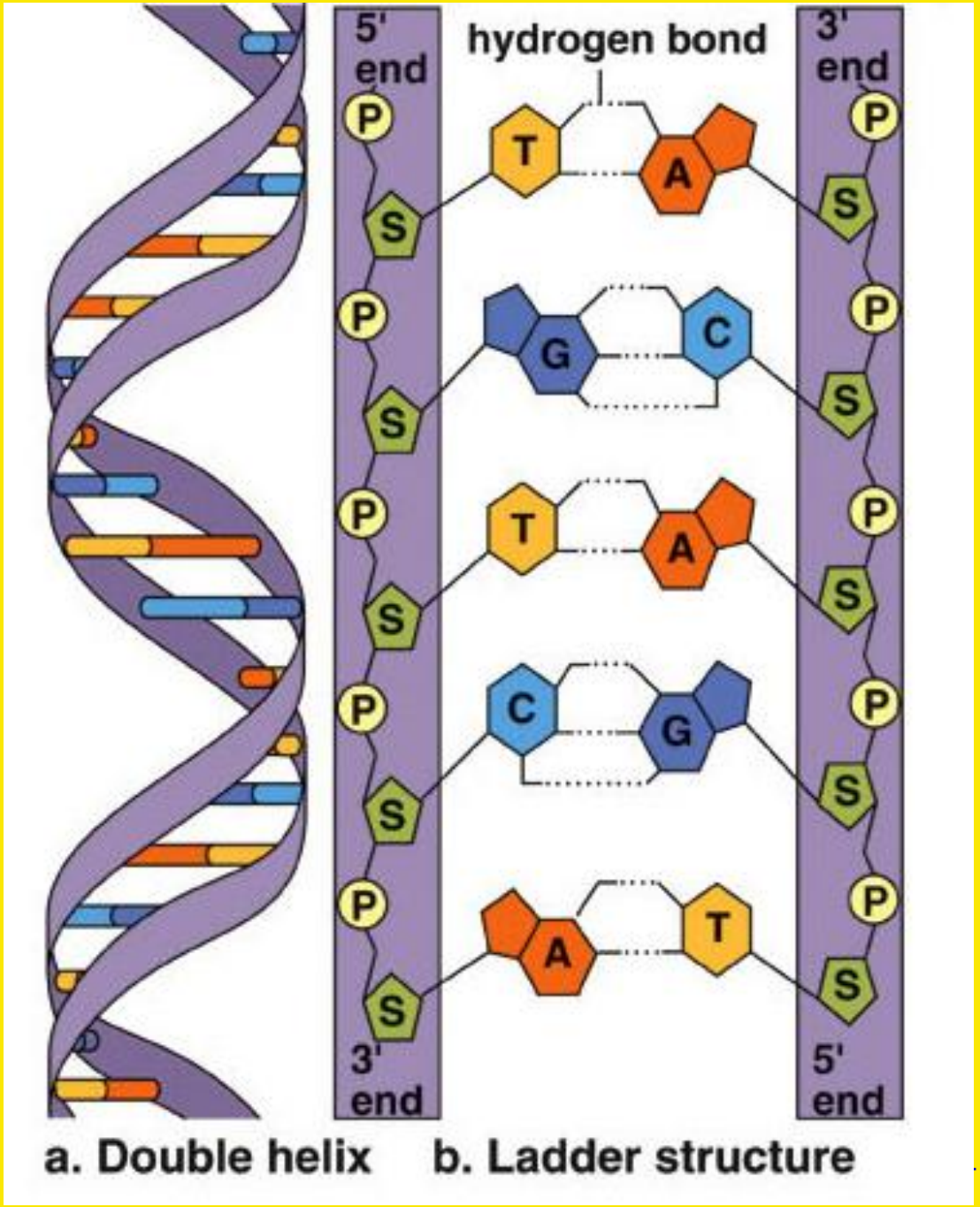
Nitrogen Rings

- Purines have single rings of carbon-nitrogen (G, A)
- Pyrimidines have double carbon-nitrogen rings (C, T)
- This is called *complementary base pairing* because a purine is always paired with a pyrimidine

5' to 3' Sugars

- When the DNA double helix unwinds, it resembles a ladder
- The sides of the ladder are the sugar-phosphate backbones
- The rungs of the ladder are the complementary paired bases
- The two DNA strands are anti-parallel (they run in opposite directions)

Anti-Parallel Strands of DNA



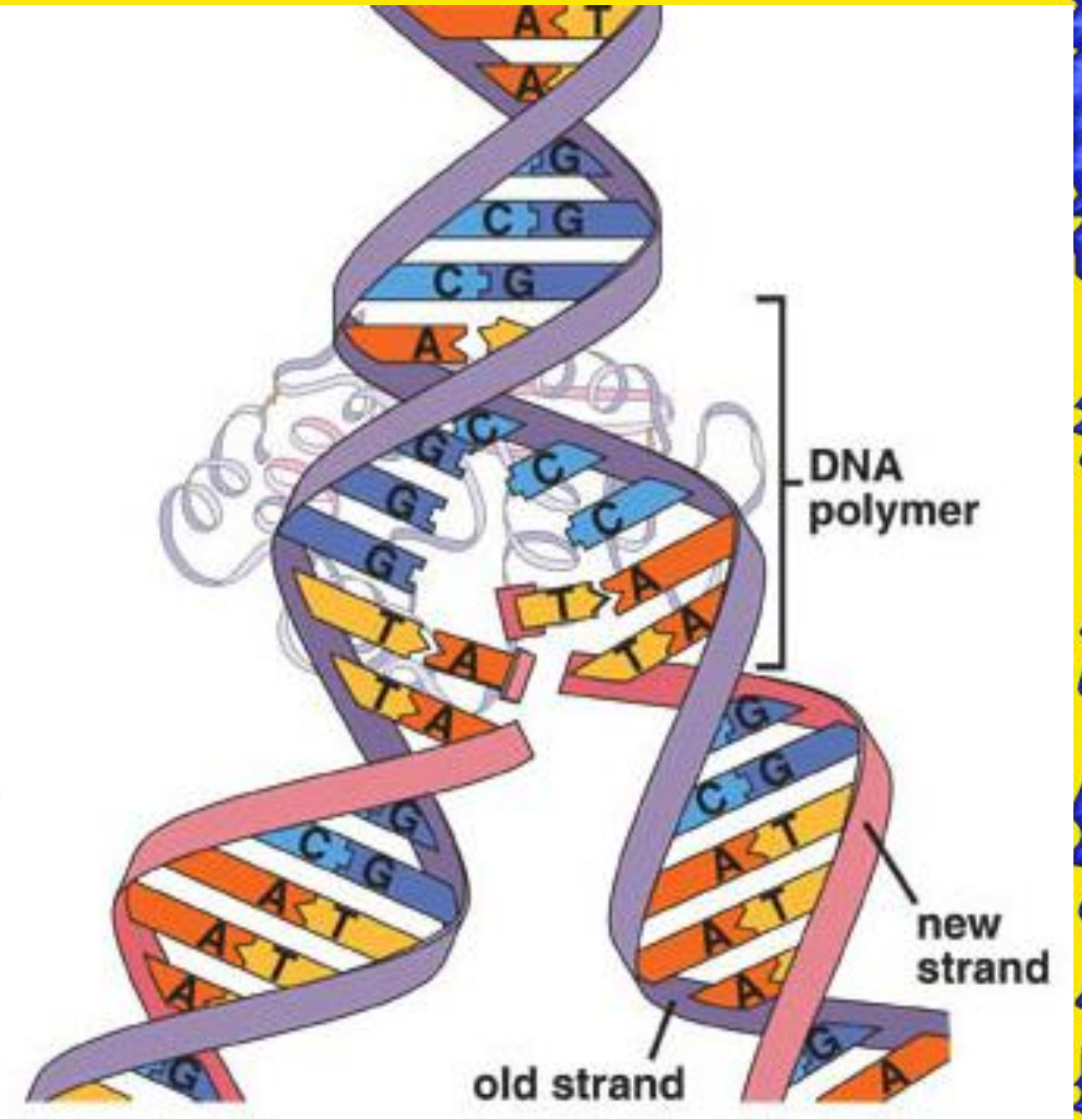
DNA Replication

What's differences between DNA Replication and DNA transcription ??

Steps in DNA Replication

- Occurs when chromosomes duplicate (make copies)
- An exact copy of the DNA is produced with the aid of the enzyme DNA polymerase
- Hydrogen bonds between bases break and enzymes "unzip" the molecule
- Each old strand of nucleotides serves as a template for each new strand
- New nucleotides move into complementary positions are joined by DNA polymerase enzyme

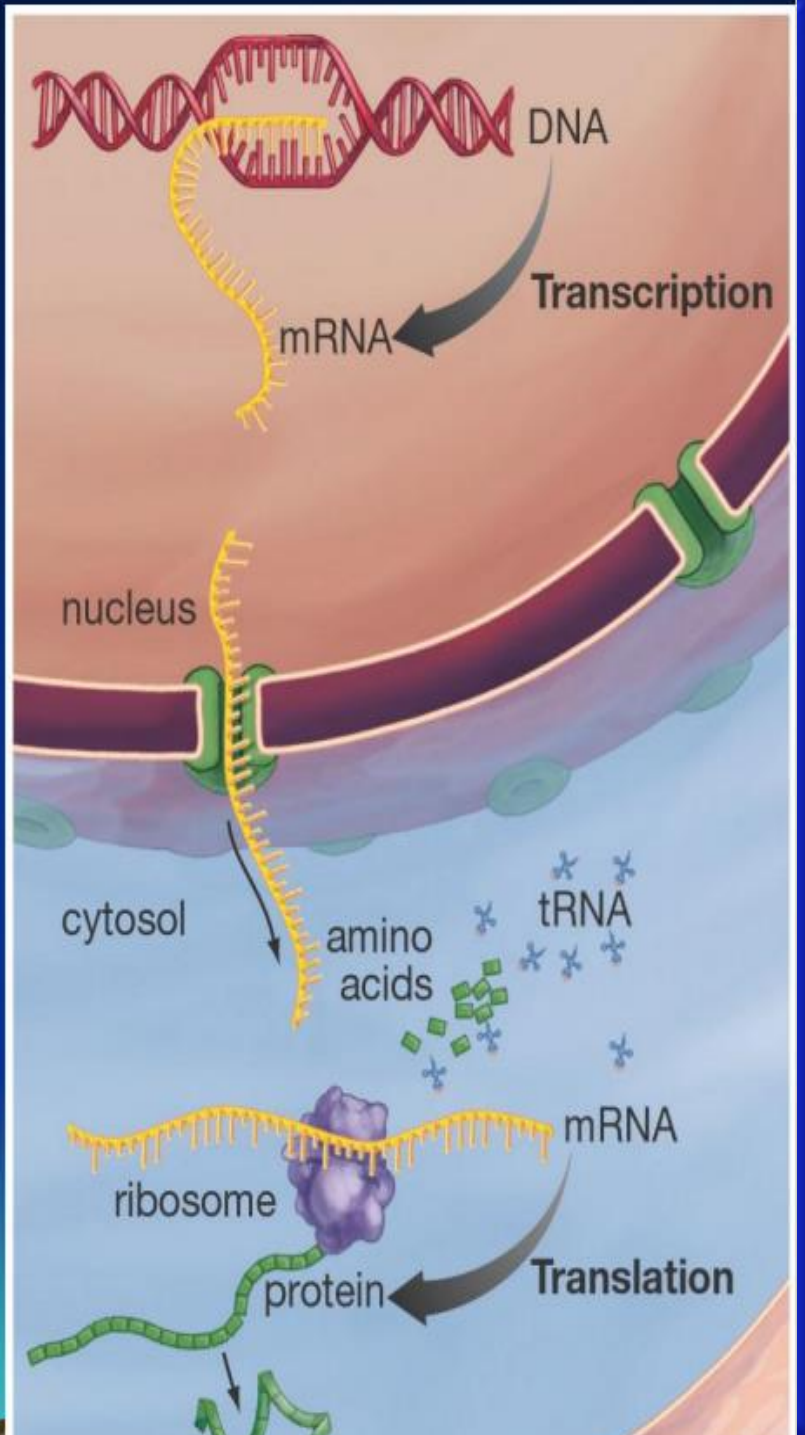
Two New, Identical DNA Strands Result from Replication



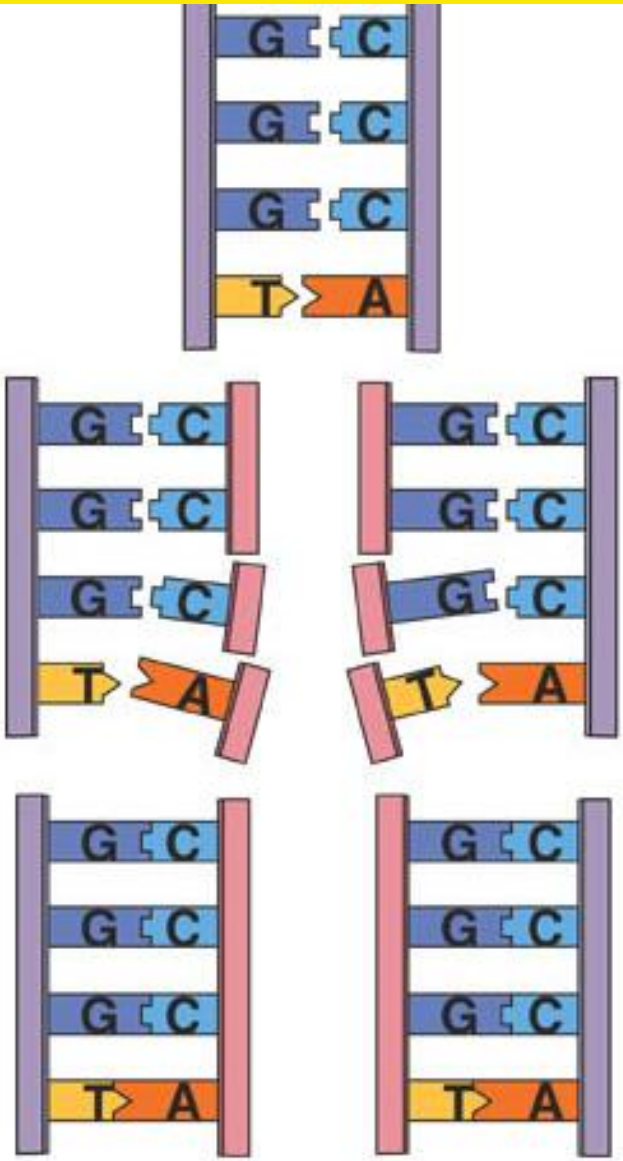
Transcription Translation

DNA → RNA → Protein → Trait

RNA processing



Another View of Replication



Parental DNA molecule contains so-called old strands hydrogen-bonded by complementary base pairing.

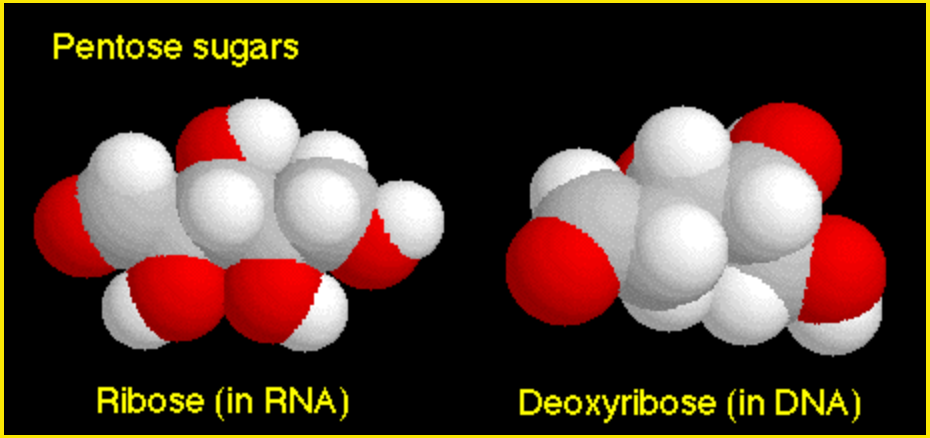
Region of replication. Parental DNA is unwound and unzipped. New nucleotides are pairing with those in old strands.

Replication is complete. Each double helix is composed of an old (parental) strand and a new (daughter) strand.

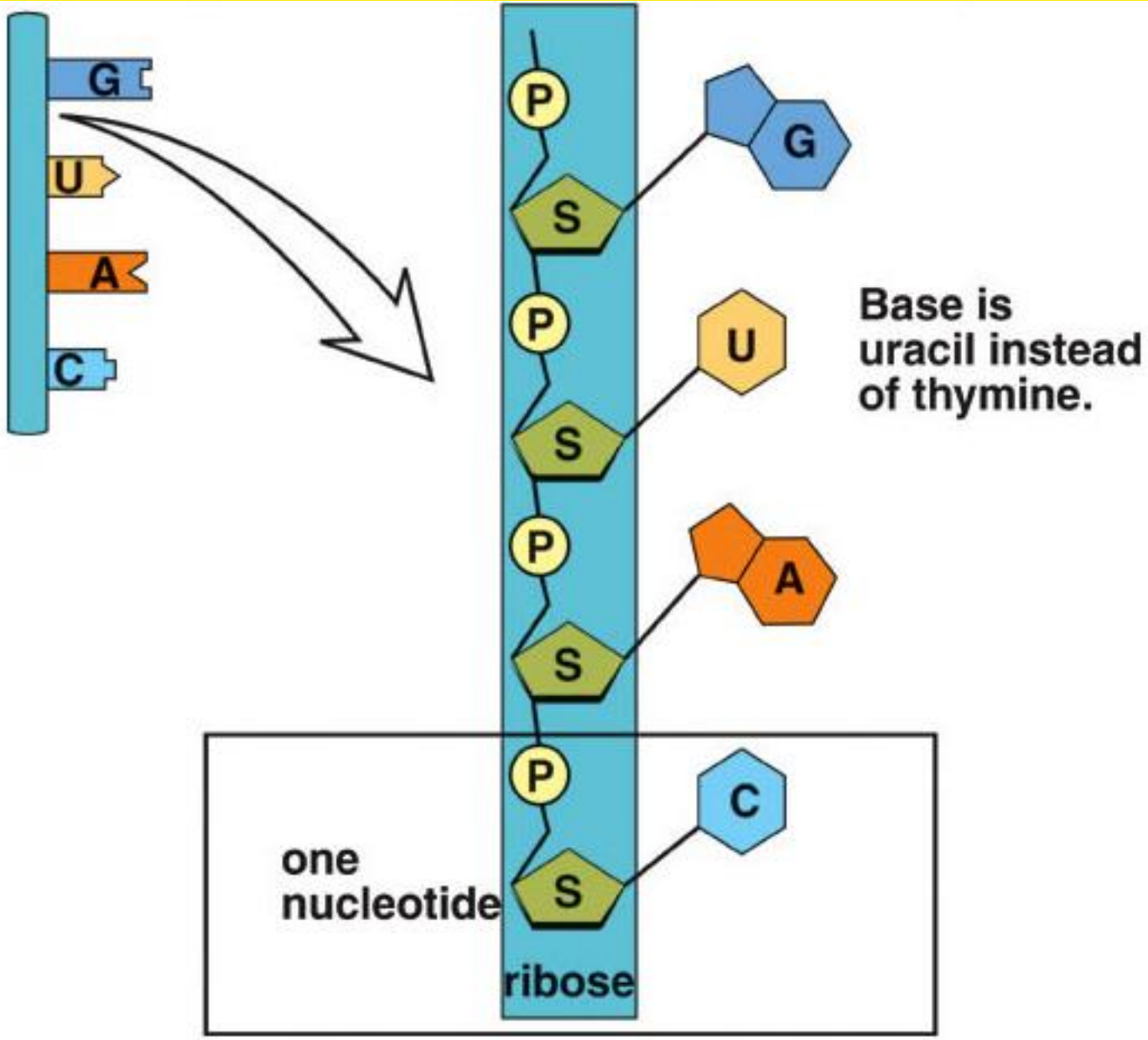
RNA

RNA Differs from DNA

1. RNA has a sugar ribose
   DNA has a sugar deoxyribose
2. RNA contains the base uracil (U)
   DNA has thymine (T)
3. RNA molecule is single-stranded
   DNA is double-stranded



Structure of RNA



Three Types of RNA

- Messenger RNA (mRNA) carries genetic information to the ribosomes
- Ribosomal RNA (rRNA), along with protein, makes up the ribosomes
- Transfer RNA (tRNA) transfers amino acids to the ribosomes where proteins are synthesized

Making a Protein

Genes & Proteins

- Proteins are made of amino acids linked together by peptide bonds
- 20 different amino acids exist
- Amino acids chains are called polypeptides
- Segment of DNA that codes for the amino acid sequence in a protein are called genes

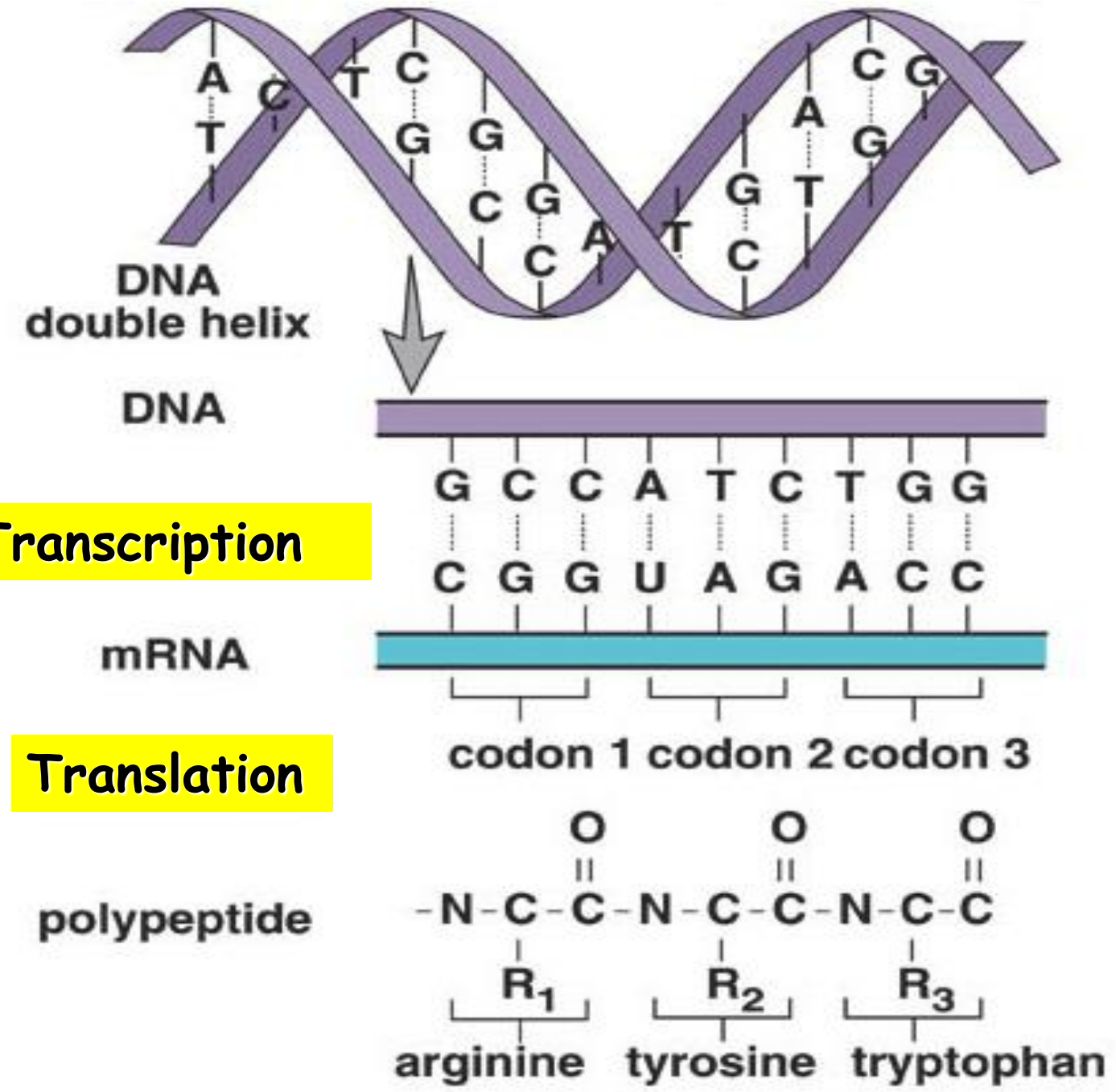
Two Parts of Protein Synthesis

- *Transcription* makes an RNA molecule complementary to a portion of DNA
- *Translation* occurs when the sequence of bases of mRNA DIRECTS the sequence of amino acids in a polypeptide

Genetic Code

- DNA contains a triplet code
- Every three bases on DNA stands for ONE amino acid
- Each three-letter unit on mRNA is called a codon
- Most amino acids have more than one codon!
- There are 20 amino acids with a possible 64 different triplets
- The code is nearly universal among living organisms

First Base	Second Base				Third Base
	U	C	A	G	
U	UUU phenylalanine	UCU serine	UAU tyrosine	UGU cysteine	U
	UUC phenylalanine	UCC serine	UAC tyrosine	UGC cysteine	C
	UUA leucine	UCA serine	UAA stop	UGA *stop*	A
	UUG leucine	UCG serine	UAG stop	UGG tryptophan	G
C	CUU leucine	CCU proline	CAU histidine	CGU arginine	U
	CUC leucine	CCC proline	CAC histidine	CGC arginine	C
	CUA leucine	CCA proline	CAA glutamine	CGA arginine	A
	CUG leucine	CCG proline	CAG glutamine	CGG arginine	G
A	AUU isoleucine	ACU threonine	AAU asparagine	AGU serine	U
	AUC isoleucine	ACC threonine	AAC asparagine	AGC serine	C
	AUA isoleucine	ACA threonine	AAA lysine	AGA arginine	A
	AUG (*start*) methionine	ACG threonine	AAG lysine	AGG arginine	G
G	GUU valine	GCU alanine	GAU aspartate	GGU glycine	U
	GUC valine	GCC alanine	GAC aspartate	GGC glycine	C
	GUA valine	GCA alanine	GAA glutamate	GGA glycine	A
	GUG valine	GCG alanine	GAG glutamate	GGG glycine	G



Transcription

Translation

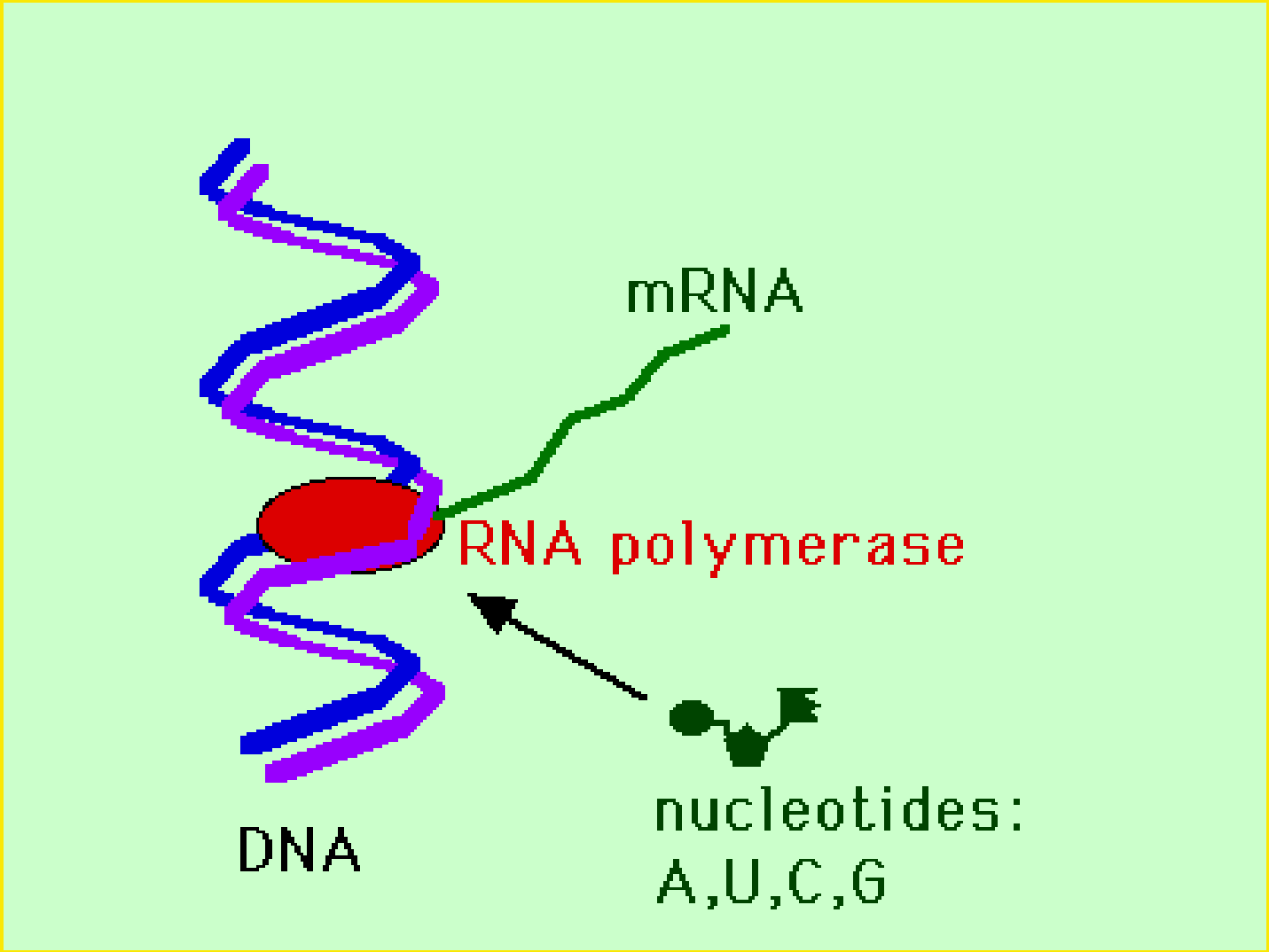
Overview of Transcription

- During transcription in the nucleus, a segment of DNA unwinds and unzips, and the DNA serves as a template for mRNA formation
- RNA polymerase joins the RNA nucleotides so that the codons in mRNA are complementary to the triplet code in DNA

Steps in Transcription

- The transfer of information in the nucleus from a DNA molecule to an RNA molecule
- Only 1 DNA strand serves as the template
- Starts at promoter DNA (TATA box)
- Ends at terminator DNA (stop)
- When complete, pre-RNA molecule is released

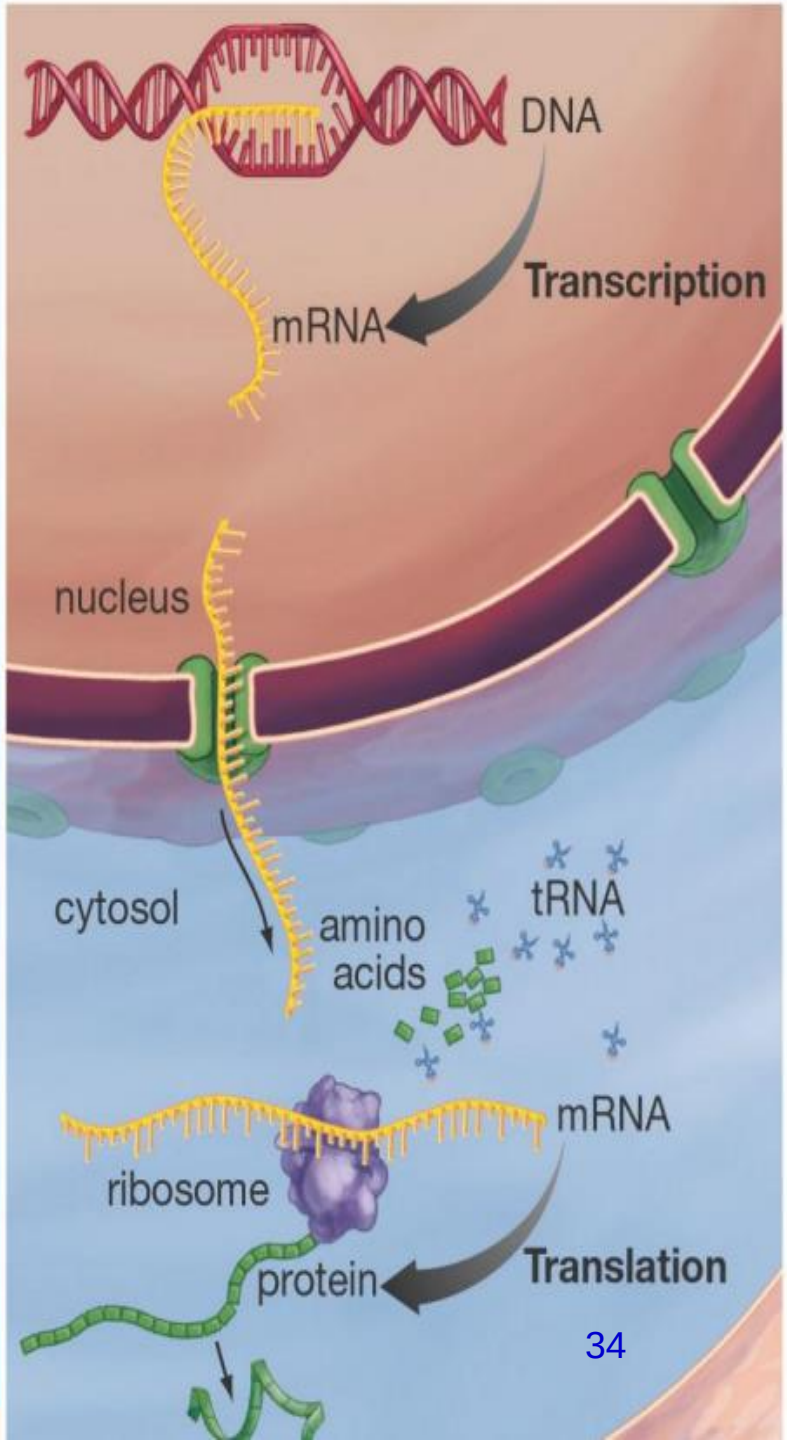
Transcription

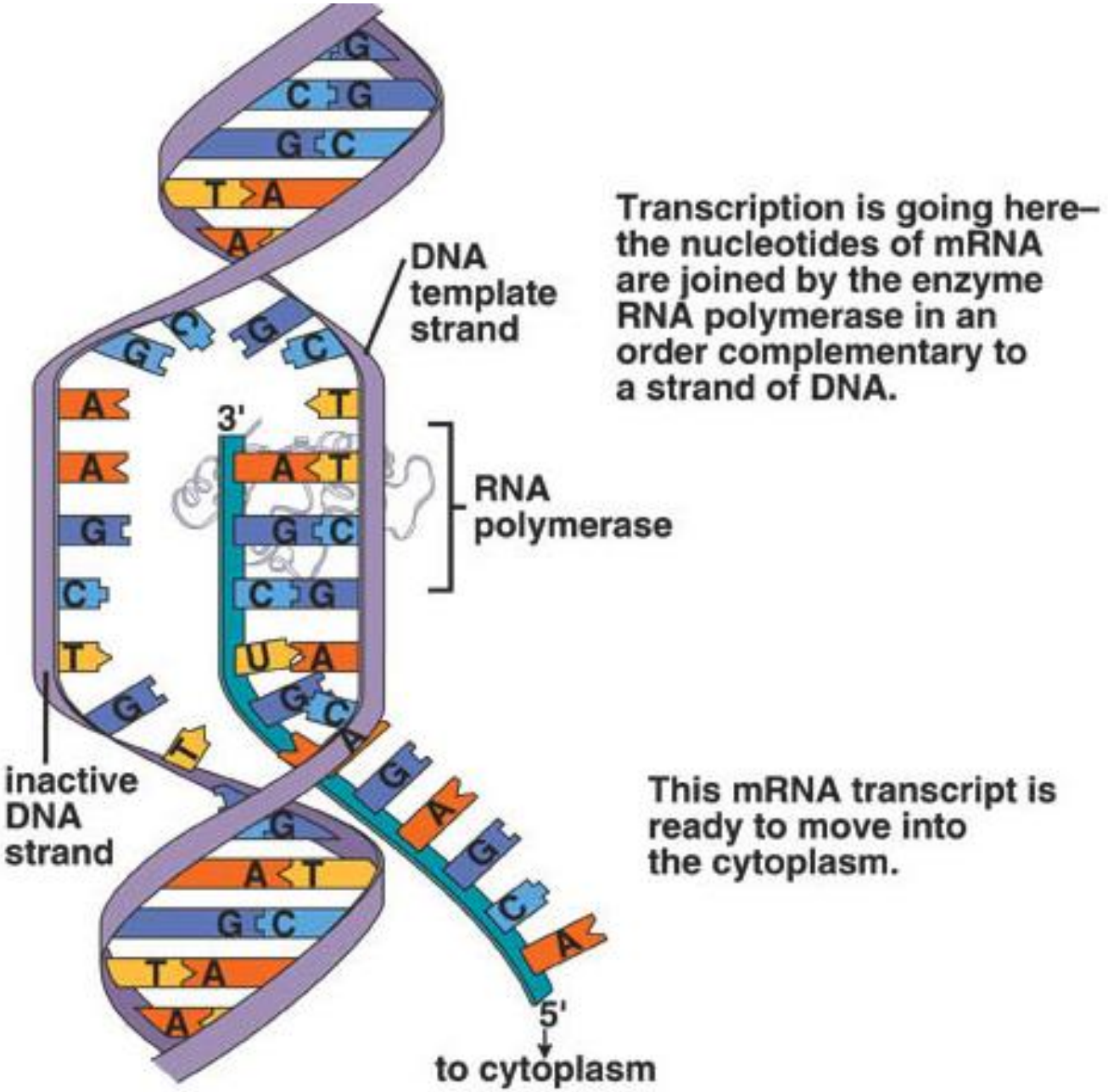


Transcription Translation

DNA → RNA → Protein → Trait

RNA processing

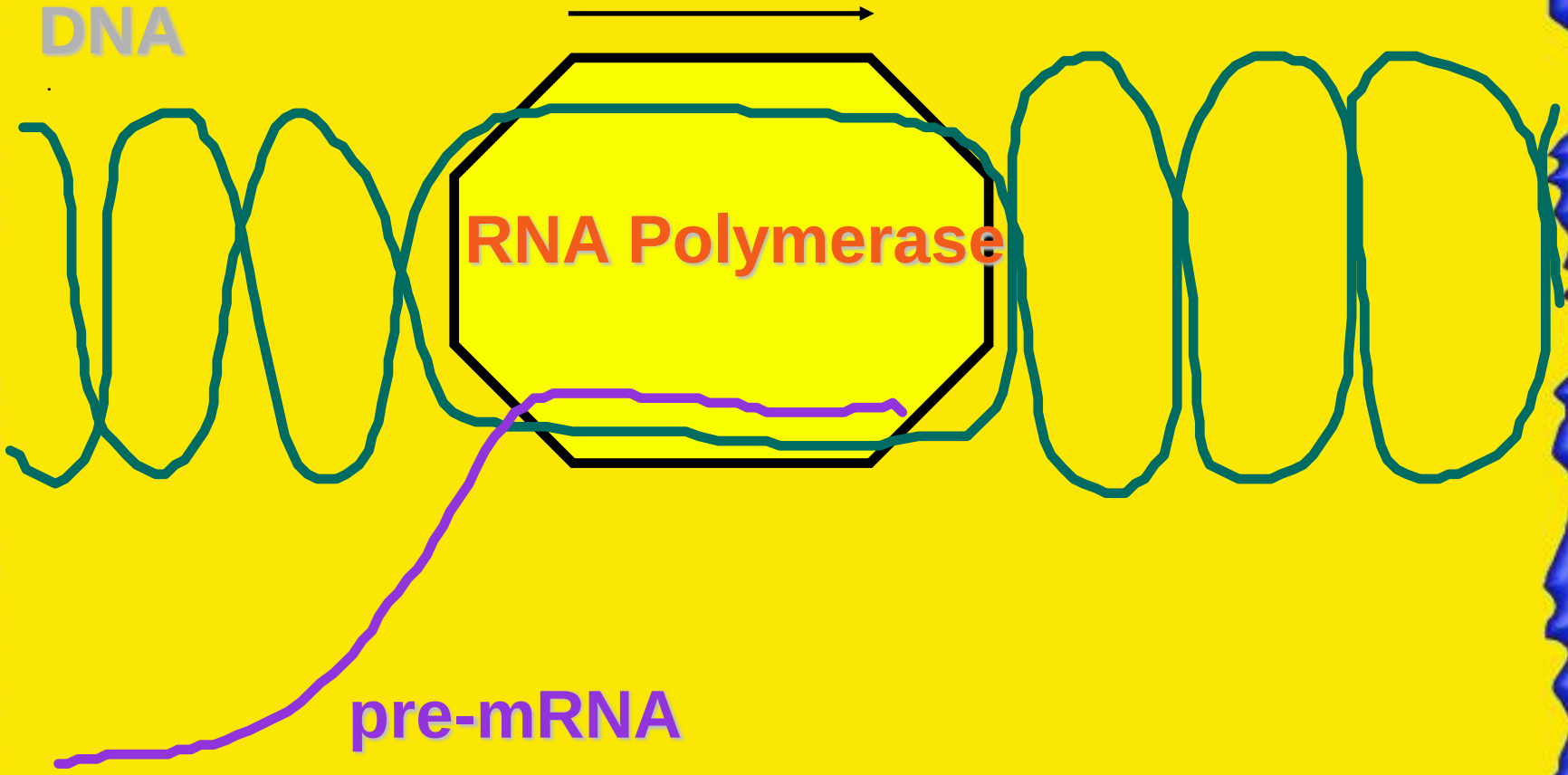



Transcription is going here– the nucleotides of mRNA are joined by the enzyme RNA polymerase in an order complementary to a strand of DNA.
DNA template strand
3'
RNA polymerase
inactive DNA strand
This mRNA transcript is ready to move into the cytoplasm.
5'
to cytoplasm

What is the enzyme responsible for the production of the mRNA molecule?

RNA Polymerase

- Enzyme found in the nucleus
- Separates the two DNA strands by breaking the hydrogen bonds between the bases
- Then moves along one of the DNA strands and links RNA nucleotides together


DNA
RNA Polymerase
pre-mRNA

Question:

- What would be the complementary RNA strand for the following DNA sequence?

DNA 5'-GCGTATG-3'

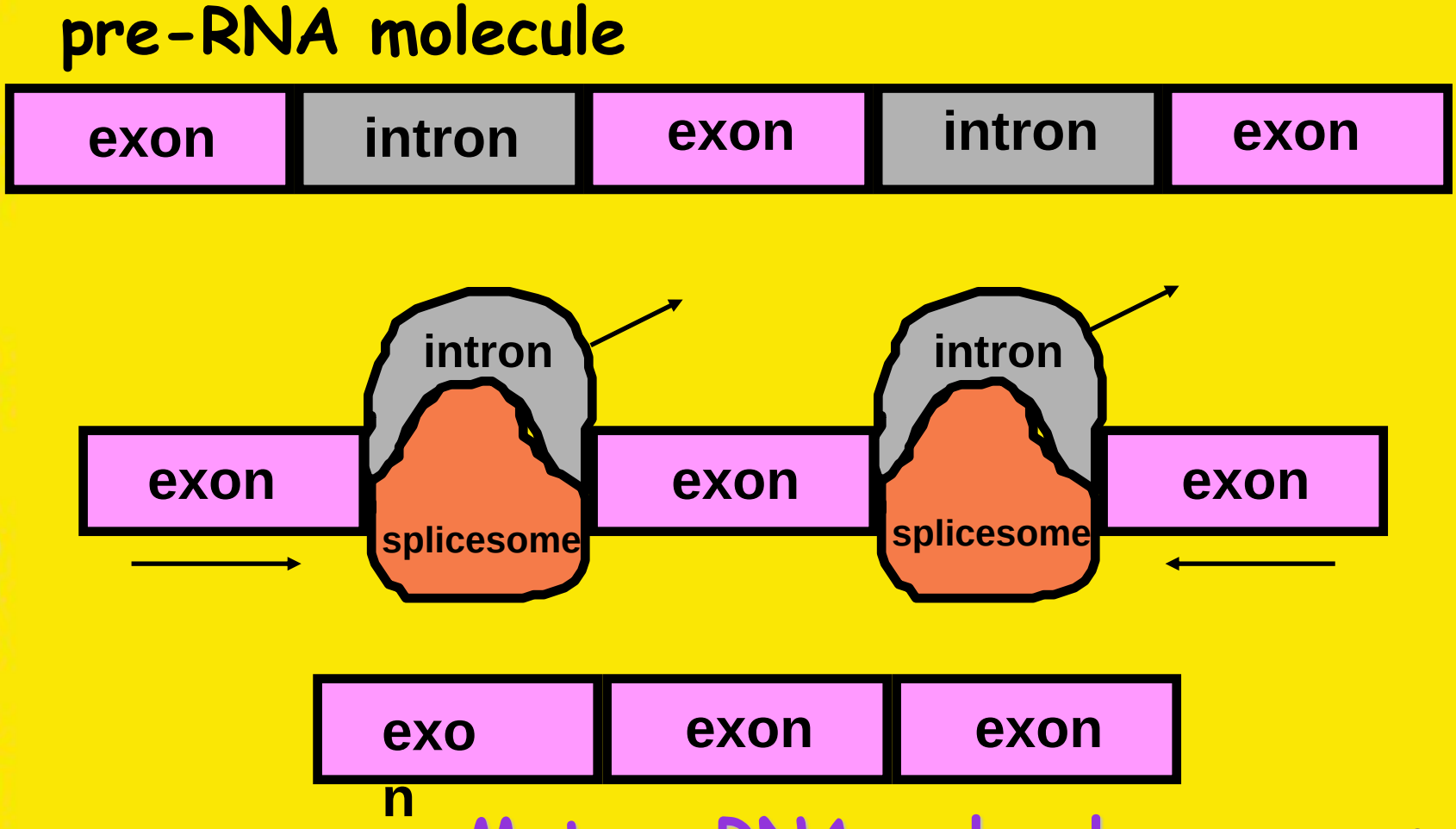
Answer:

- DNA 5'-GCGTATG-3'
- RNA 3'-CGCAUAC-5'

Processing Pre-mRNA

- Also occurs in the nucleus
- Pre-mRNA made up of segments called introns & exons
- Exons code for proteins, while introns do NOT!
- Introns spliced out by splicesome-enzyme and exons re-join
- End product is a mature RNA molecule that leaves the nucleus to the cytoplasm

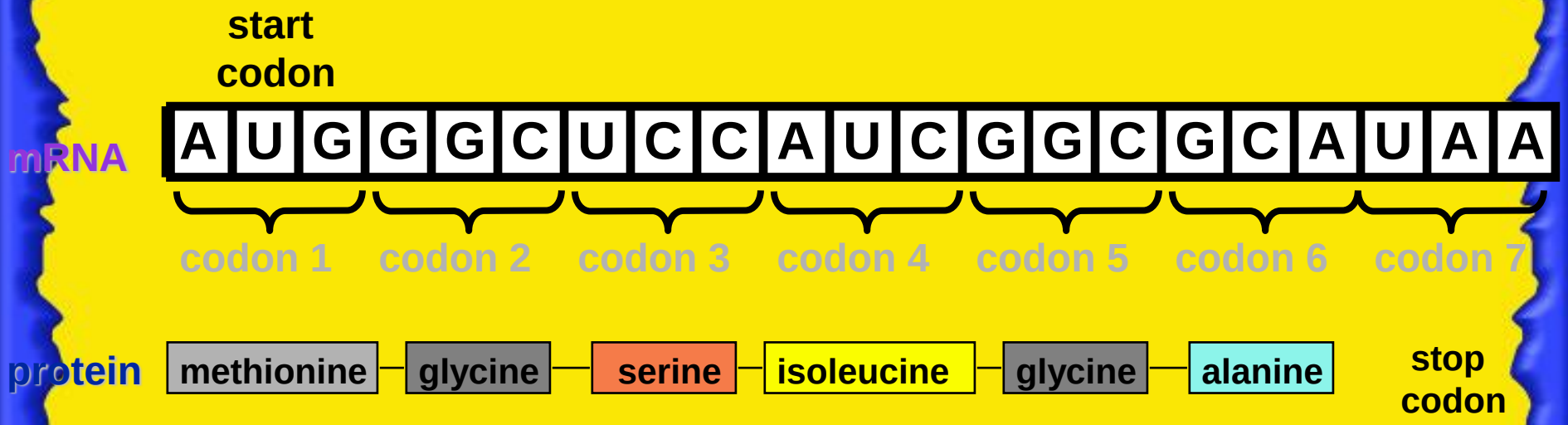
RNA Processing



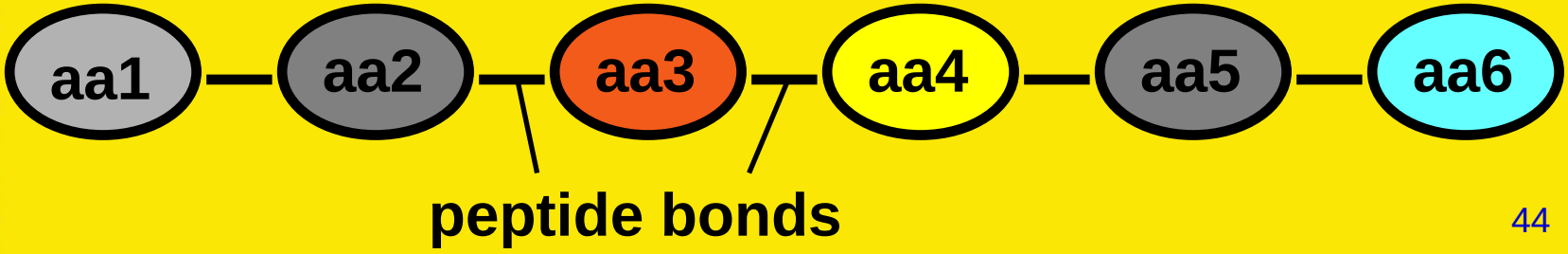
Messenger RNA (mRNA)

- Carries the information for a specific protein
- Made up of 500 to 1000 nucleotides long
- Sequence of 3 bases called codon
- AUG – methionine or start codon
- UAA, UAG, or UGA – stop codons

Messenger RNA (mRNA)



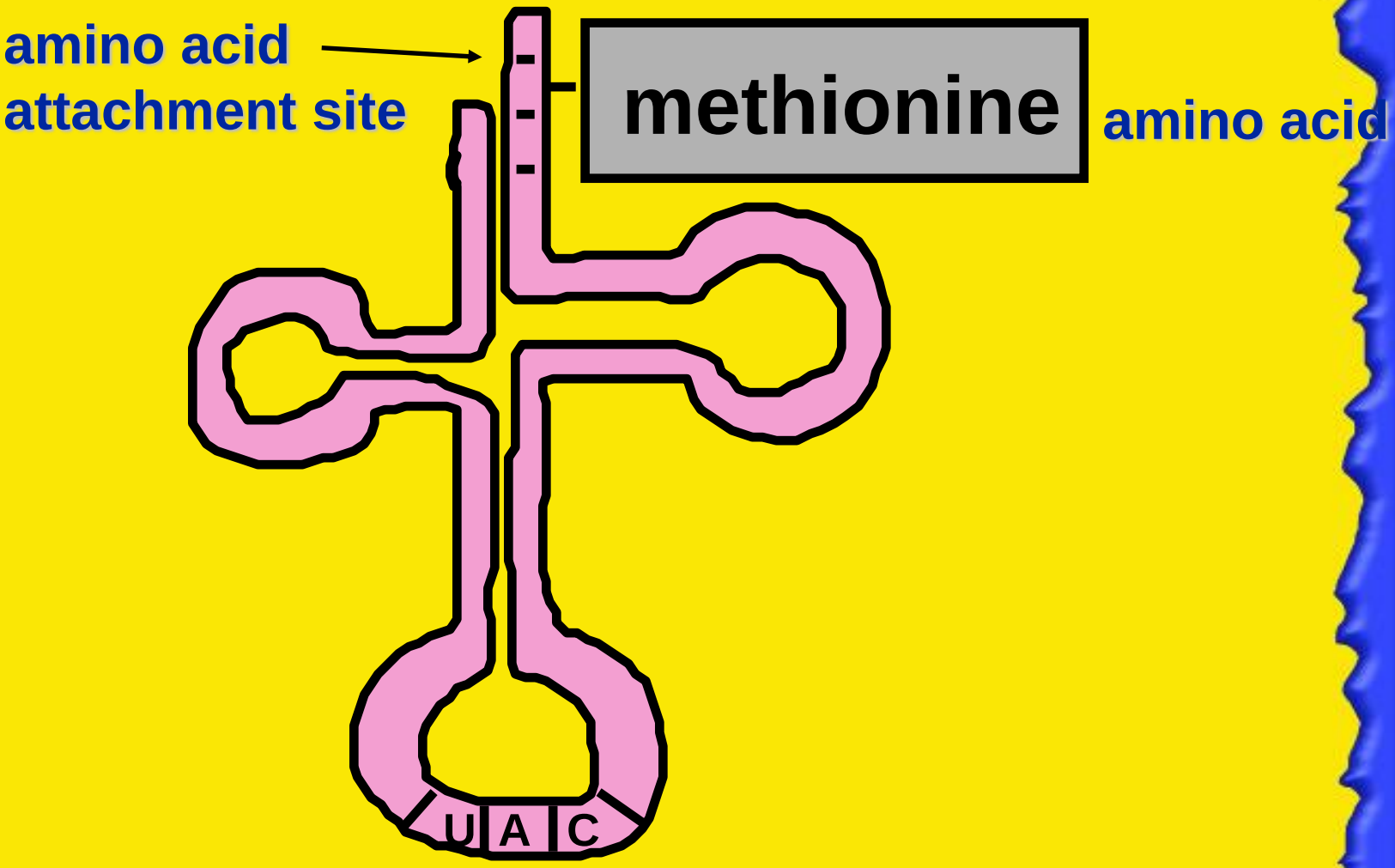
Primary structure of a protein



Transfer RNA (tRNA)

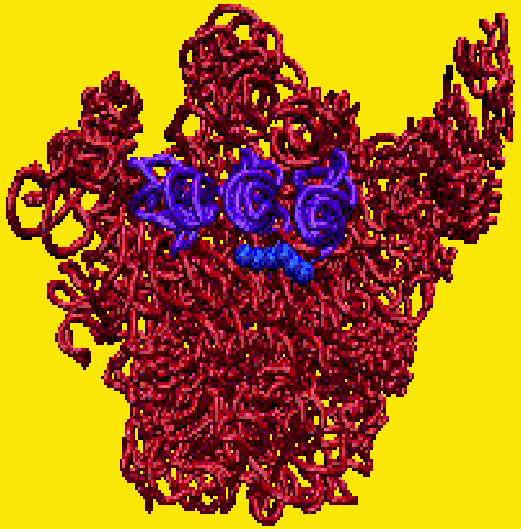
- Made up of 75 to 80 nucleotides long
- Picks up the appropriate amino acid floating in the cytoplasm
- Transports amino acids to the mRNA
- Have anticodons that are complementary to mRNA codons
- Recognizes the appropriate codons on the mRNA and bonds to them with H-bonds

Transfer RNA (tRNA)



Ribosomal RNA (rRNA)

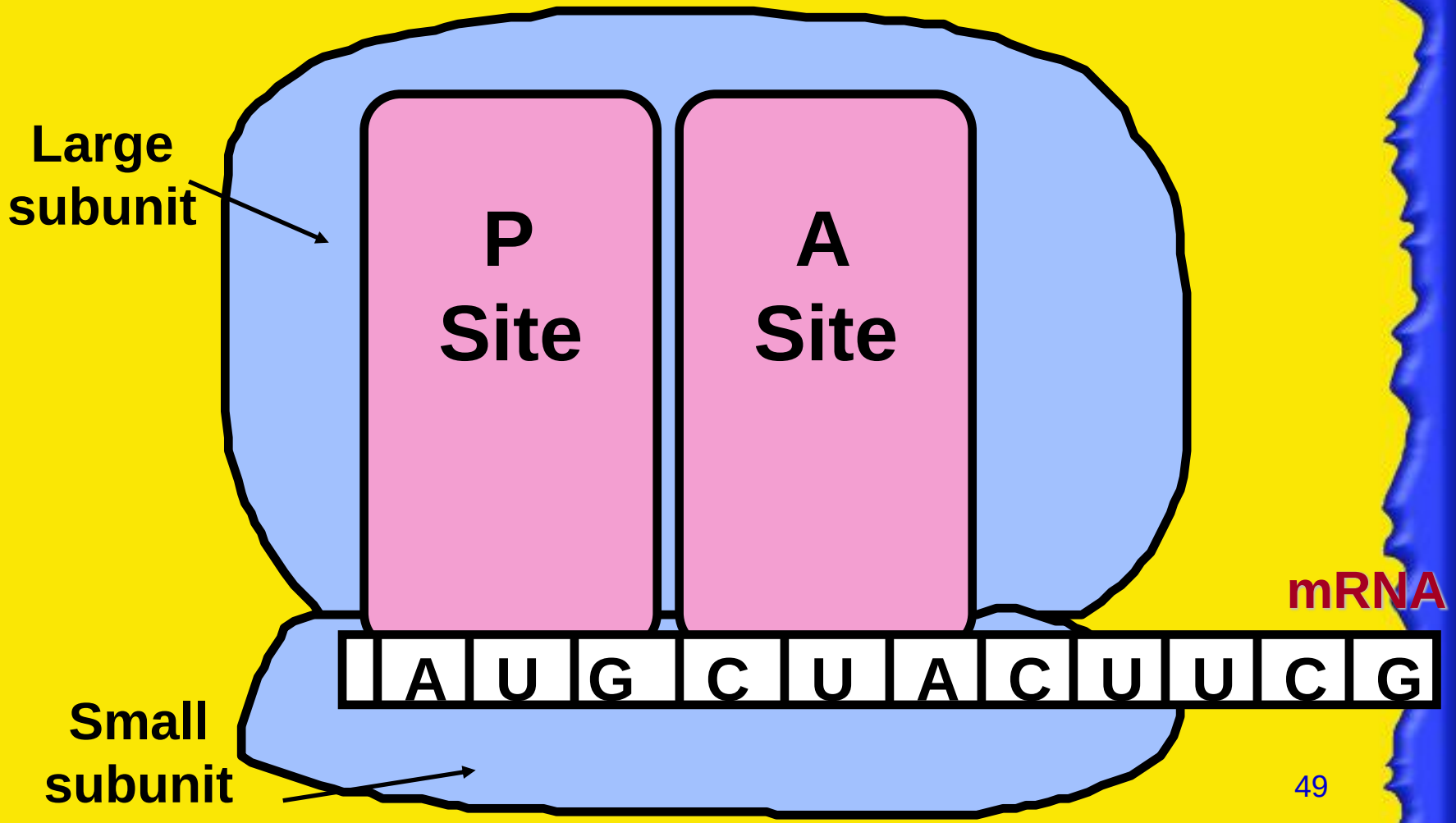
- Made up of rRNA is 100 to 3000 nucleotides long
- Made inside the nucleus of a cell
- Associates with proteins to form ribosomes



Ribosomes

- Made of a large and small subunit
- Composed of rRNA (40%) and proteins (60%)
- Have two sites for tRNA attachment --- P and A

Ribosomes



Translation

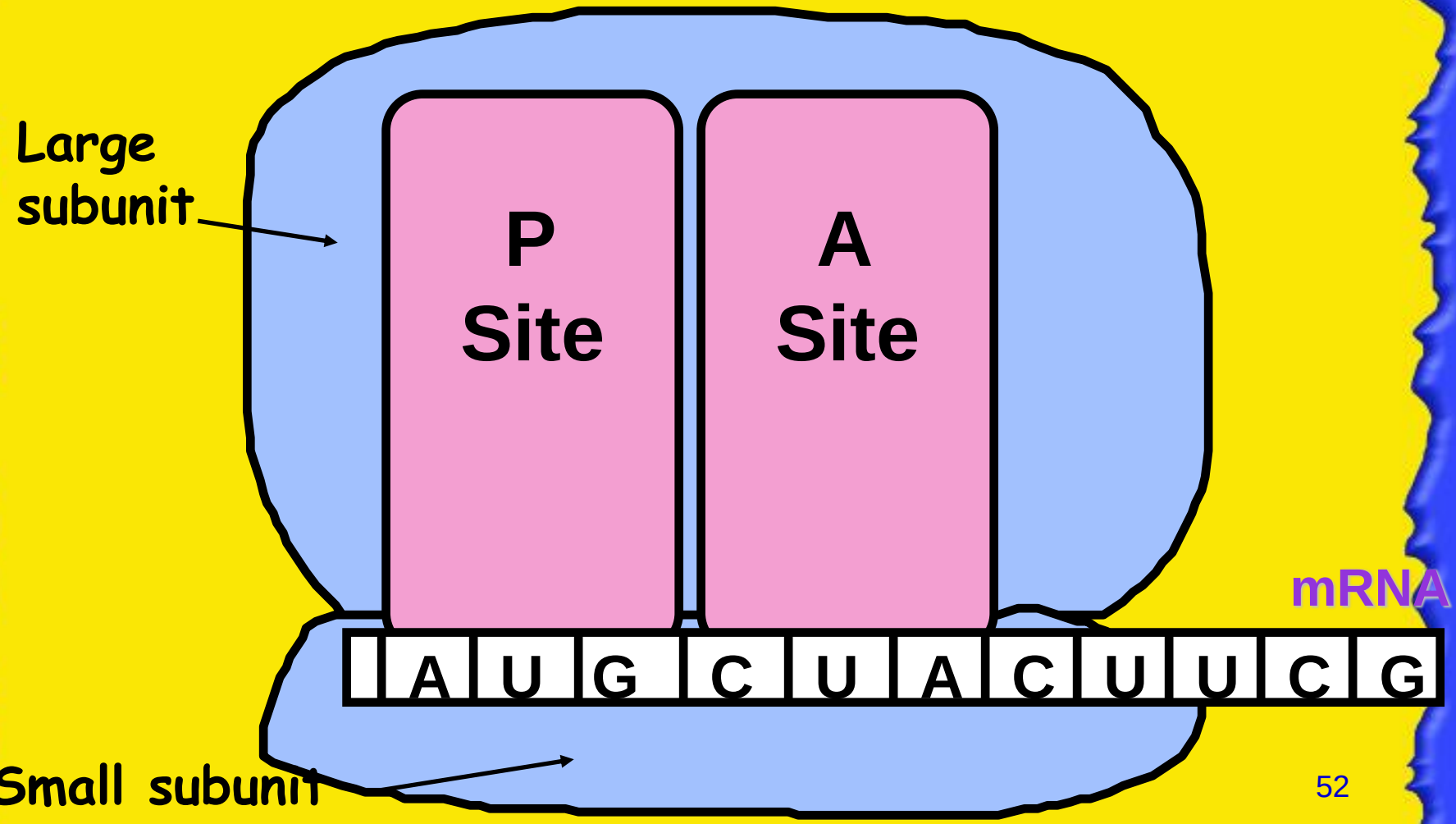
- Synthesis of proteins in the cytoplasm
- Involves the following:
  1. mRNA (codons)
  2. tRNA (anticodons)
  3. ribosomes
  4. amino acids

Translation

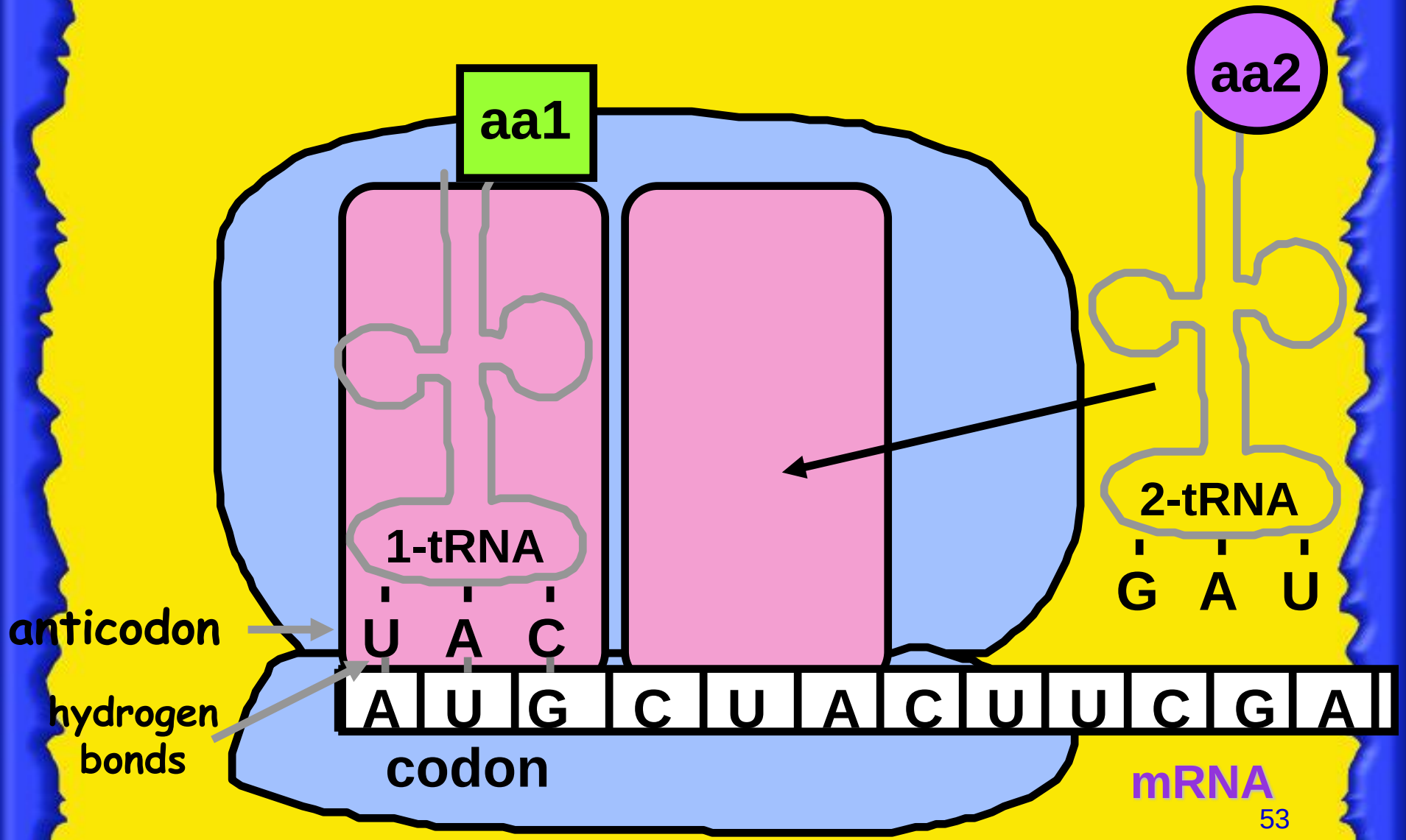
- Three steps:
  1. initiation: start codon (AUG)
  2. elongation: amino acids linked
  3. termination: stop codon (UAG, UAA, or UGA).

Let's Make a Protein !

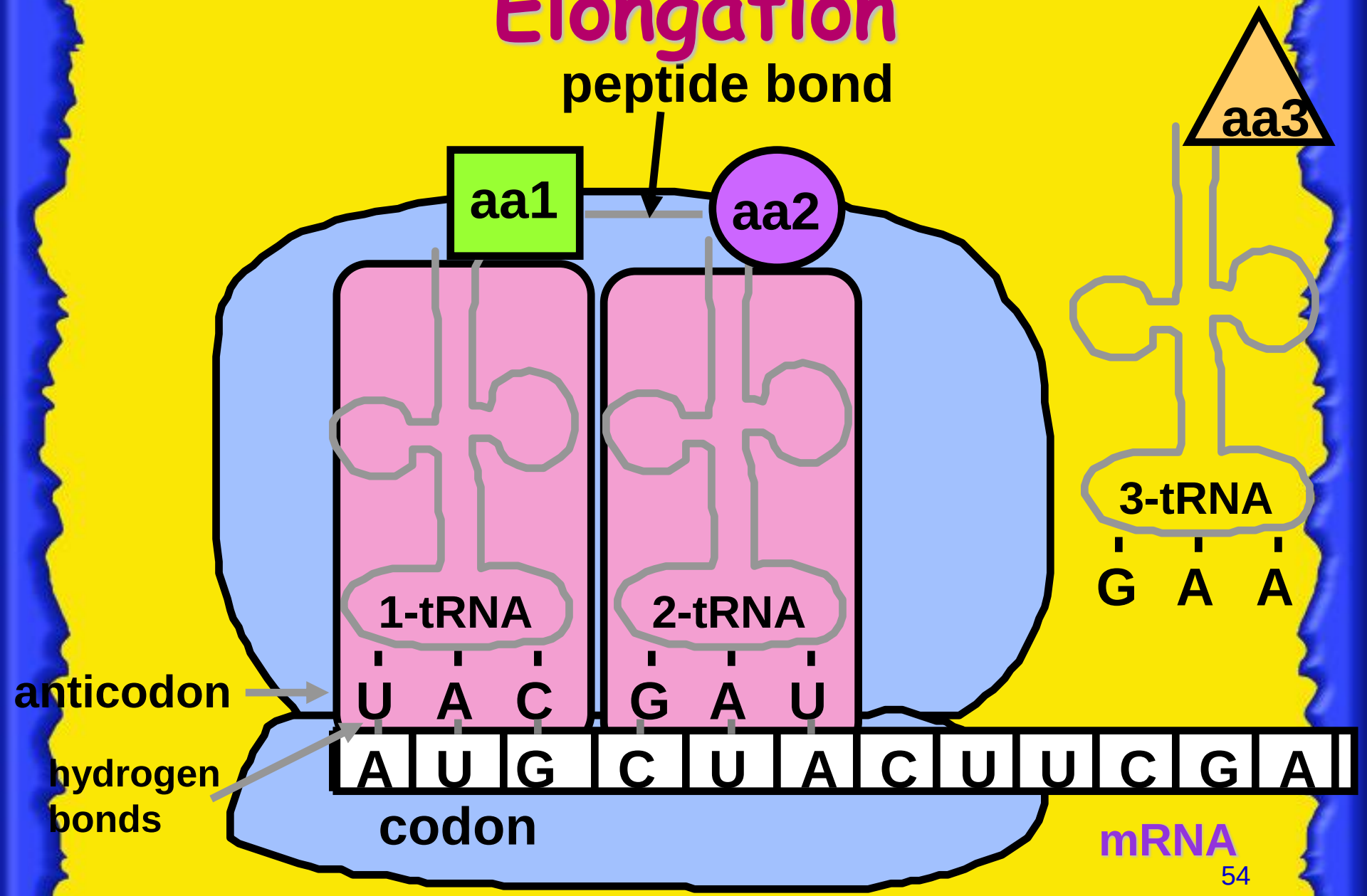
mRNA Codons Join the Ribosome

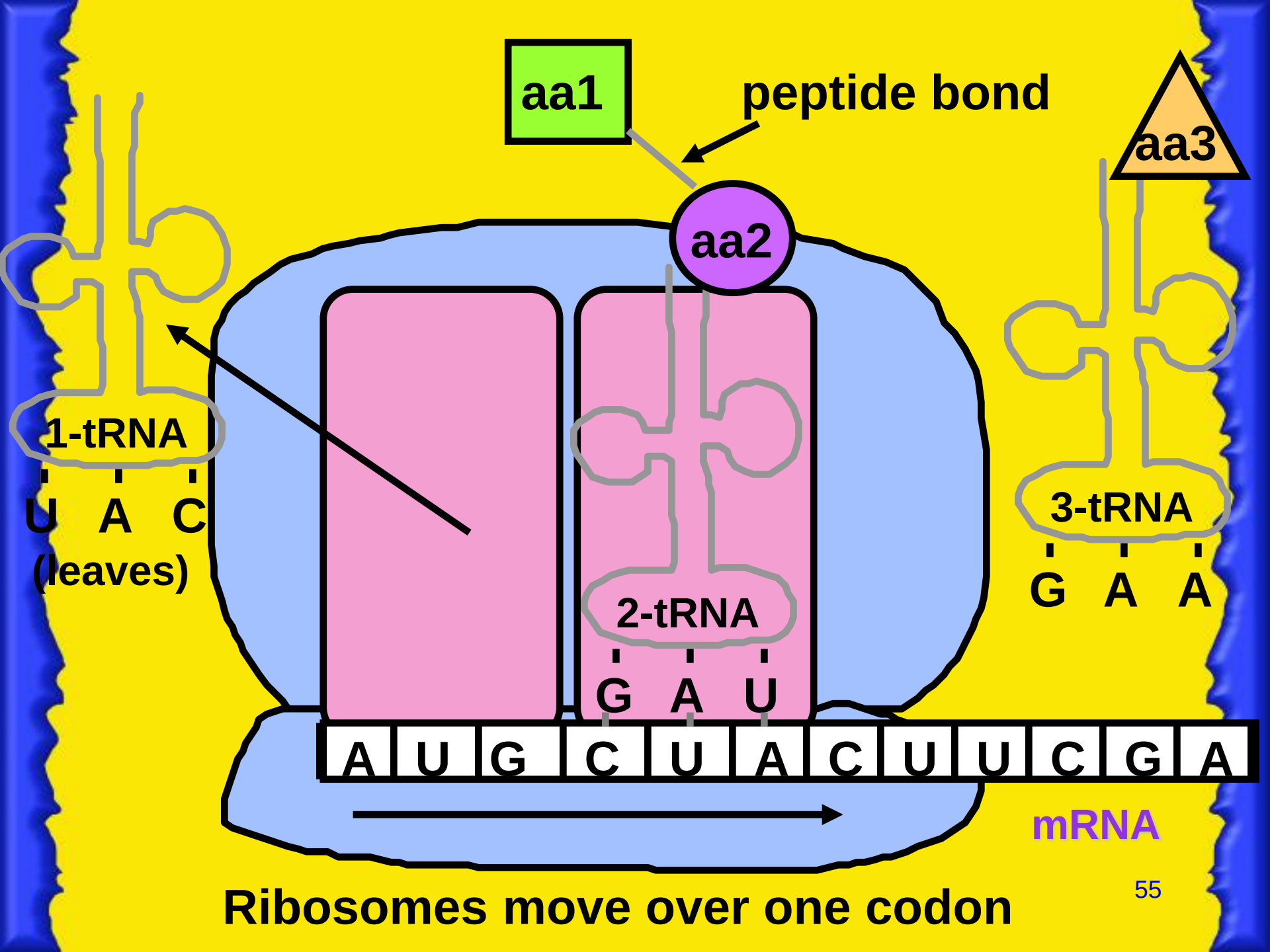


Initiation

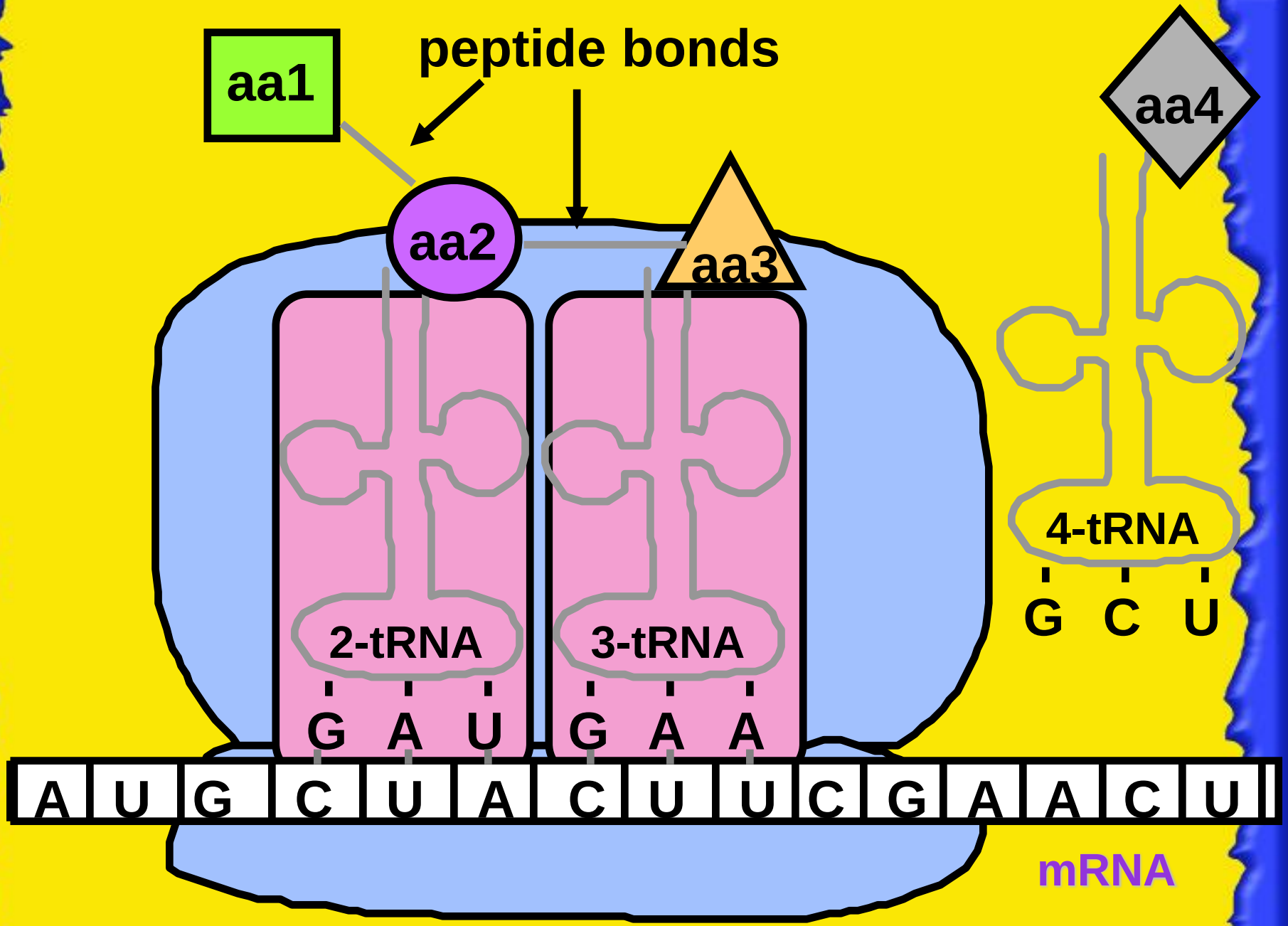

aa2
aa1
2-tRNA
1-tRNA
G A U
anticodon
U A C
hydrogen bonds
A U G C U A C U U C G A
codon
mRNA

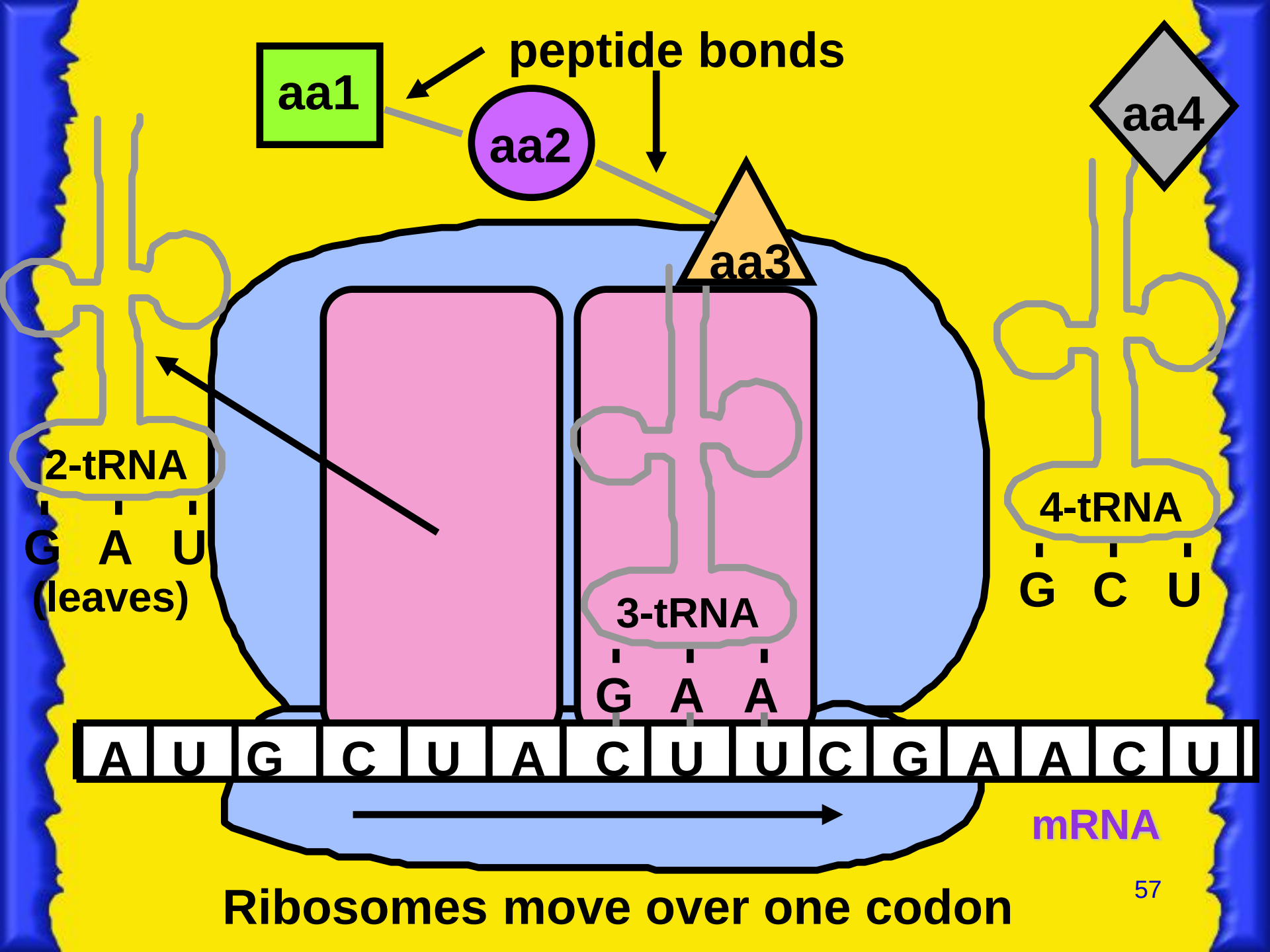
Elongation

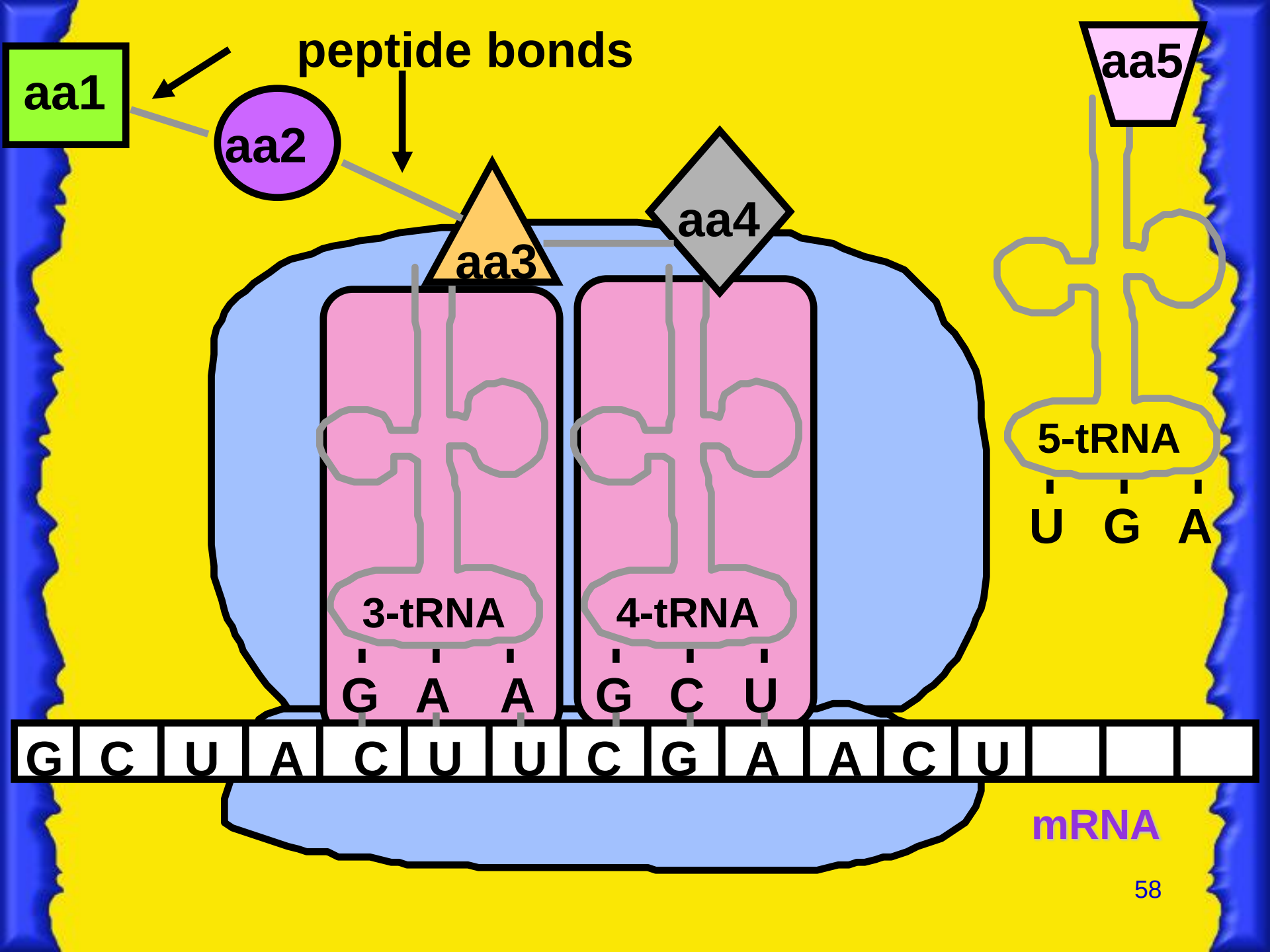

peptide bond
aa1
aa2
aa3
1-tRNA
2-tRNA
3-tRNA
G A A
anticodon
U A C
G A U
hydrogen bonds
A U G C U A C U U C G A
codon
mRNA

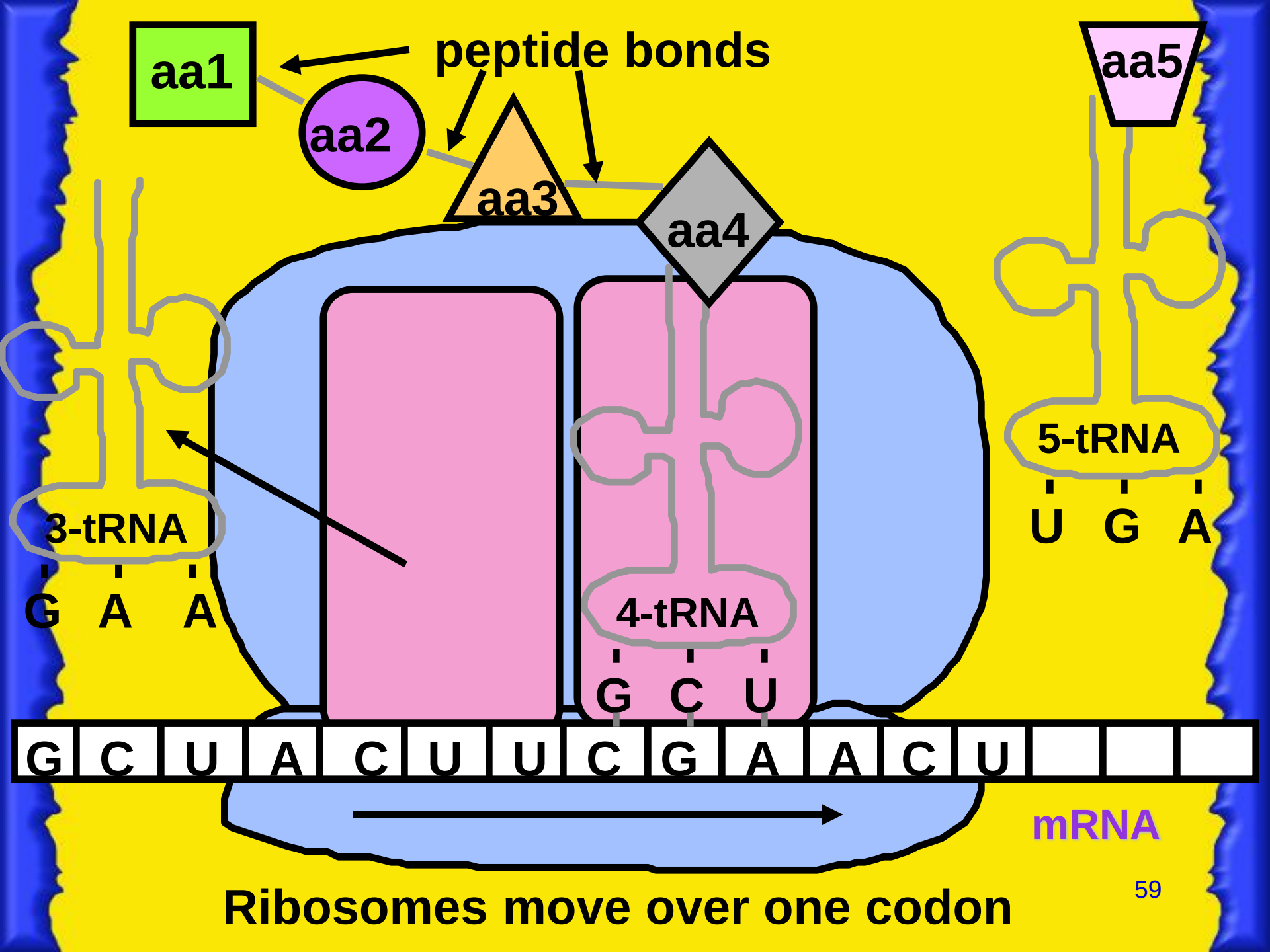


Ribosomes move over one codon


aa1
peptide bonds
aa4
aa2
aa3
4-tRNA
G C U
2-tRNA
3-tRNA
G A U
G A A
A U G C U A C U U C G A A C U
mRNA

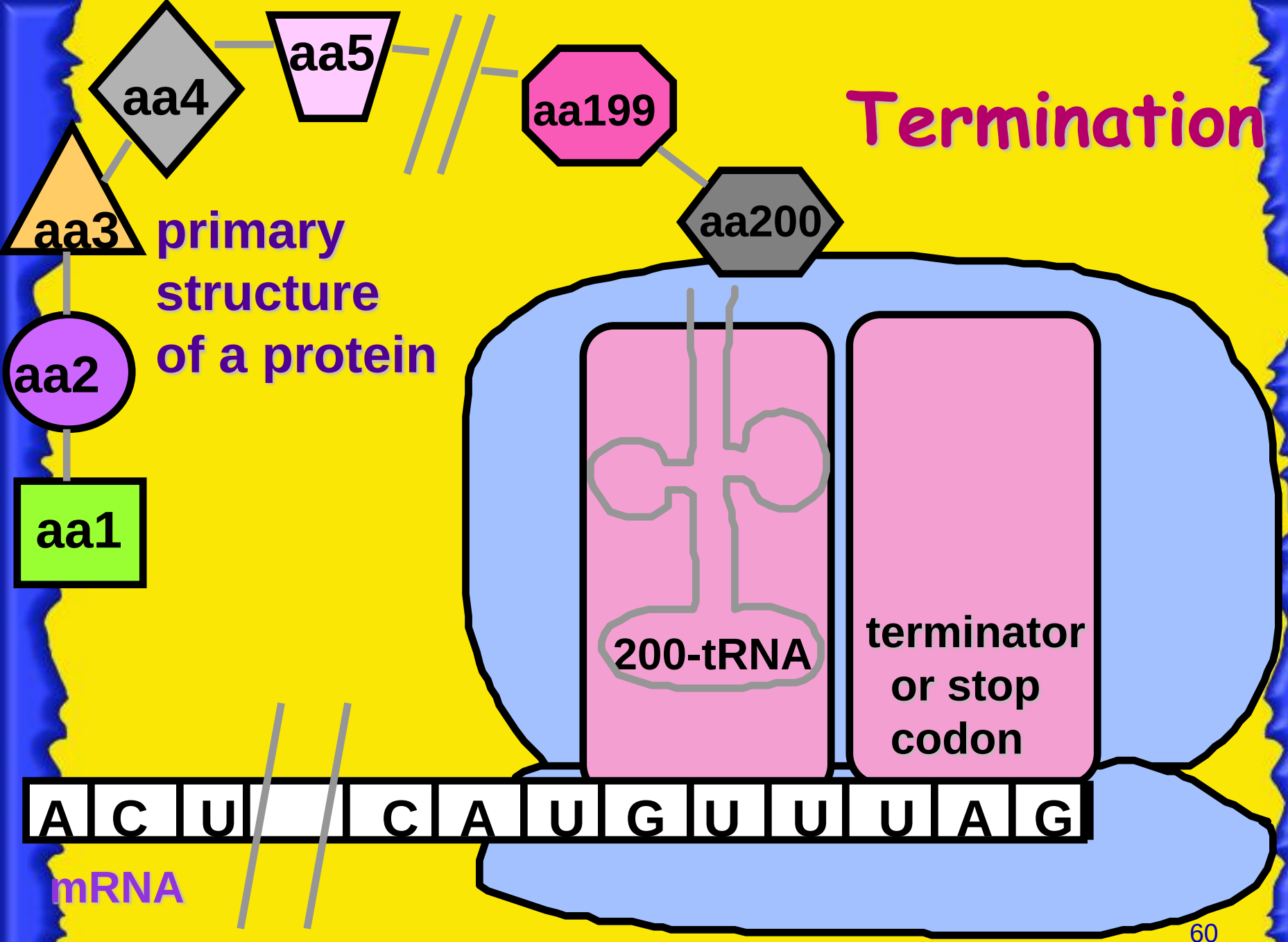

peptide bonds
aa1
aa2
aa3
aa4
2-tRNA
G A U
(leaves)
3-tRNA
G A A
4-tRNA
G C U
A U G C U A C U U C G A A C U
mRNA
Ribosomes move over one codon


peptide bonds
aa1
aa2
aa3
aa4
aa5
3-tRNA
G A A
4-tRNA
G C U
5-tRNA
U G A
G C U A C U U C G A A C U
mRNA



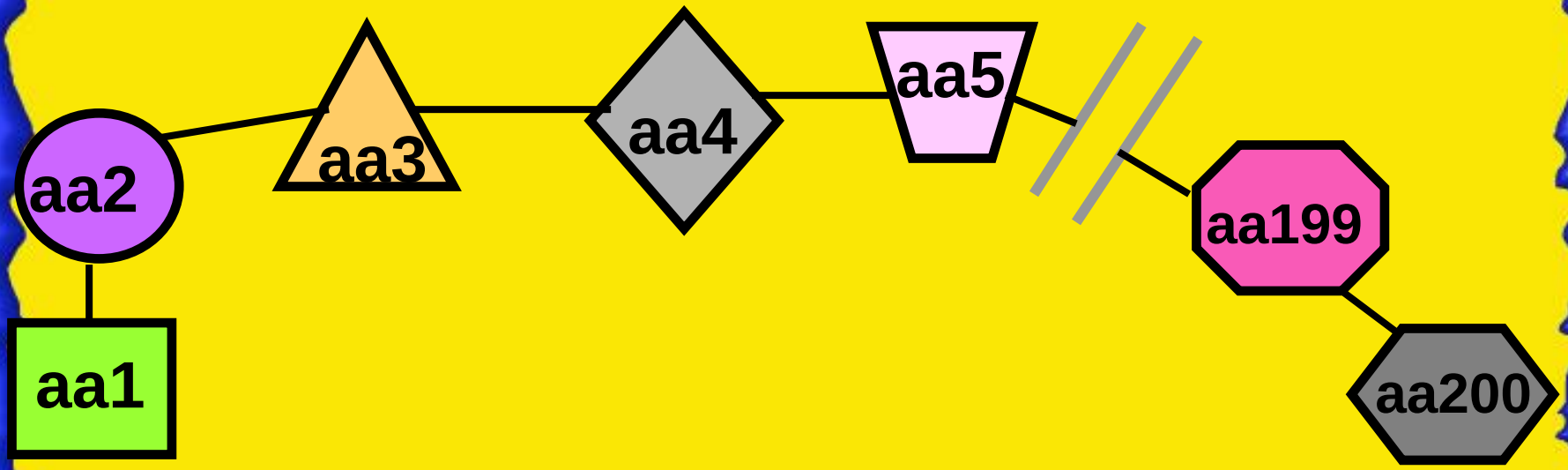
Ribosomes move over one codon

Termination



End Product –The Protein!

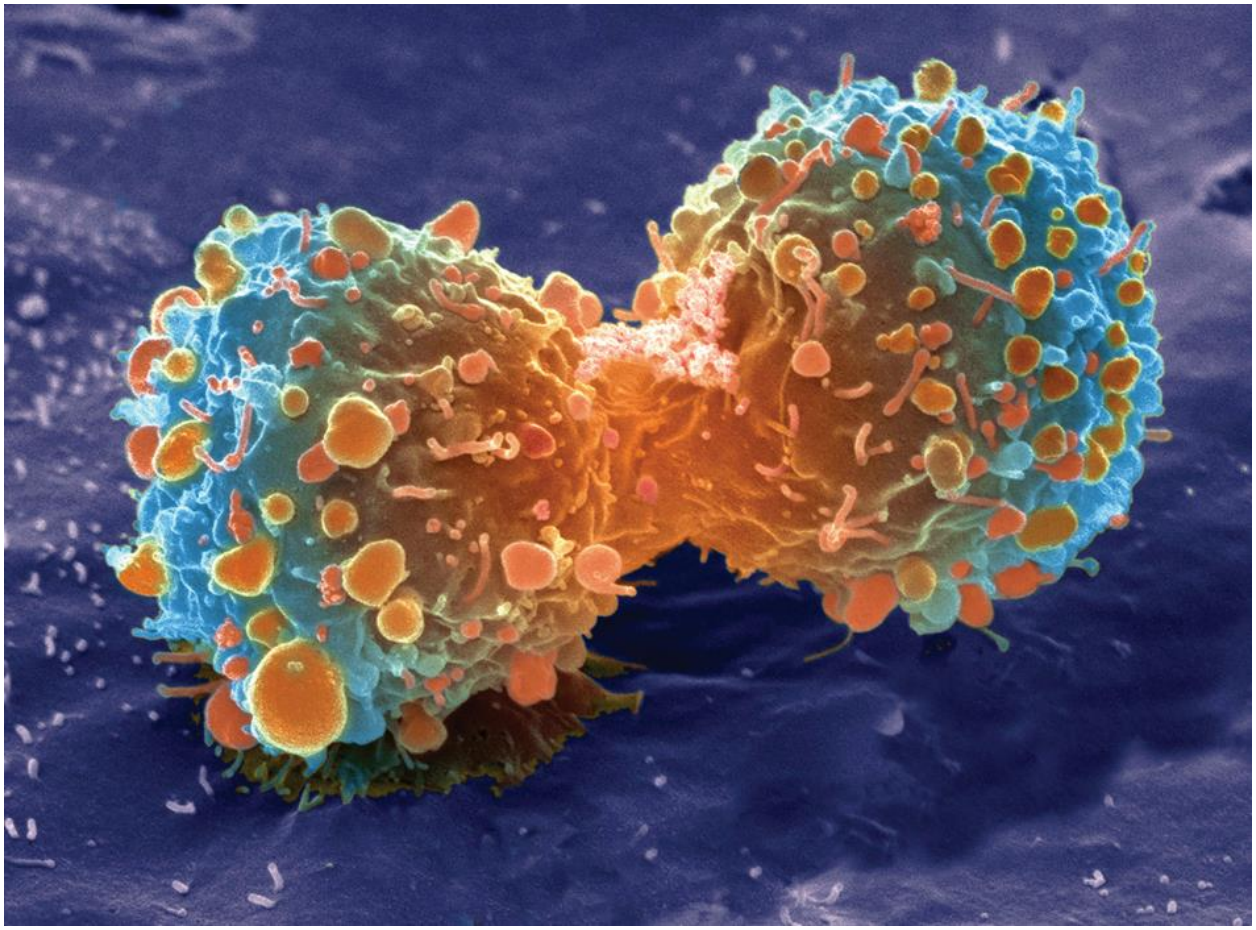
- The end products of protein synthesis is a primary structure of a protein
- A sequence of amino acid bonded together by peptide bonds



5.1 The Cell Cycle

KEY CONCEPT

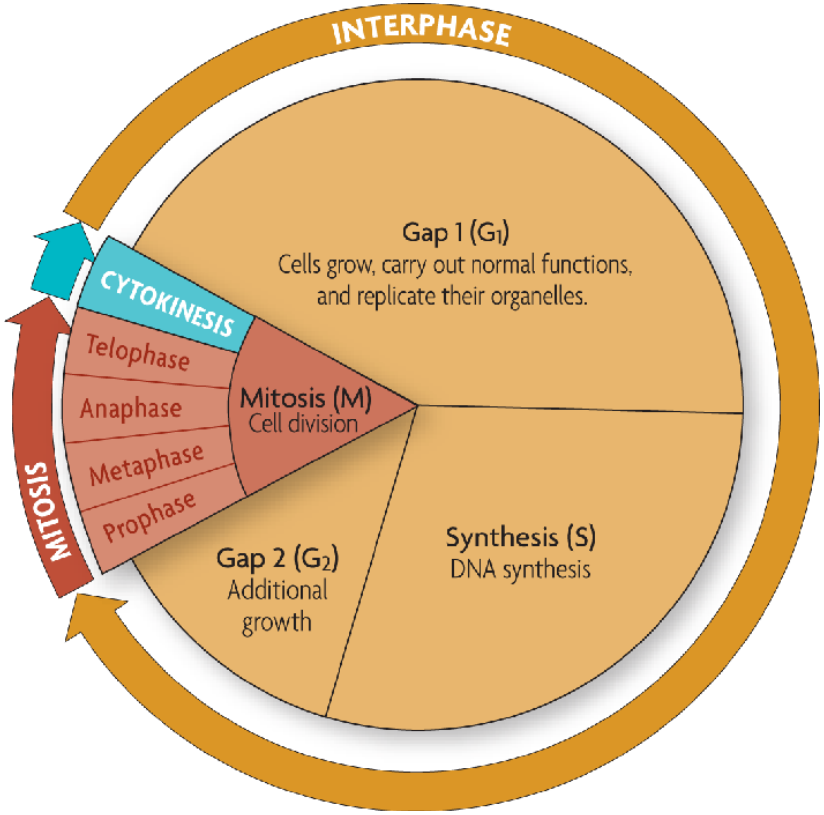
Cells have distinct phases of growth, reproduction, and normal functions.



5.1 The Cell Cycle

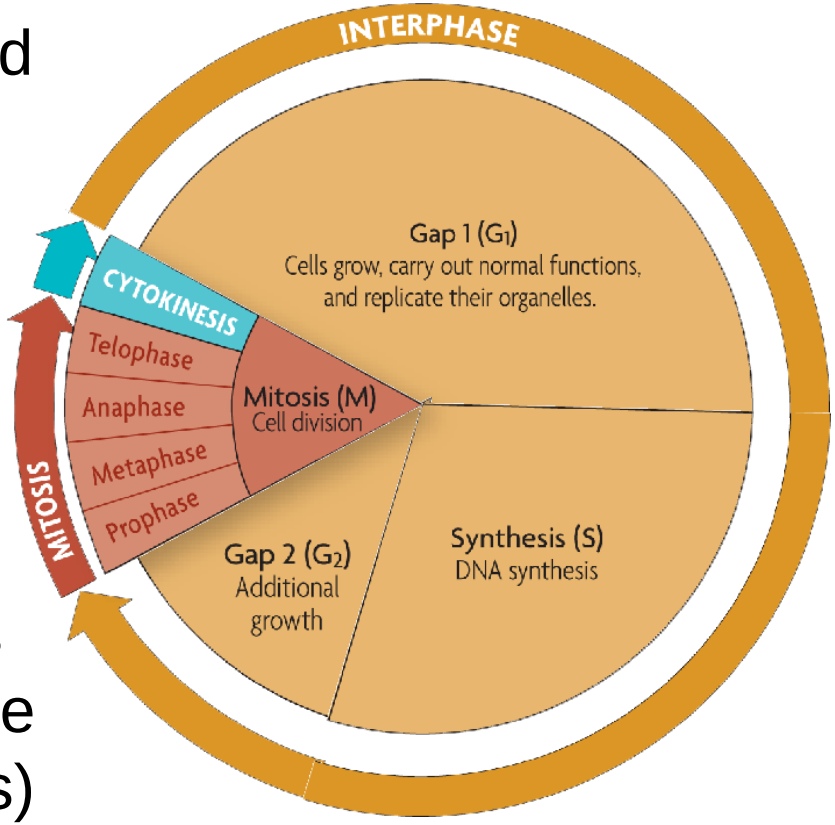
The cell cycle has four main stages.

- The cell cycle is a regular pattern of growth, DNA replication, and cell division.



5.1 The Cell Cycle

- The main stages of the cell cycle are gap 1, synthesis, gap 2, and mitosis.
  - Gap 1 (G_1): cell growth and normal functions
  - DNA synthesis (S): copies DNA
  - Gap 2 (G_2): additional growth
  - Mitosis (M): includes division of the cell nucleus (mitosis) and division of the cell cytoplasm (cytokinesis)



- Mitosis occurs only if the cell is large enough and the DNA undamaged.

5.1 The Cell Cycle

Cells divide at different rates.

- The rate of cell division varies with the need for those types of cells.

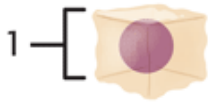
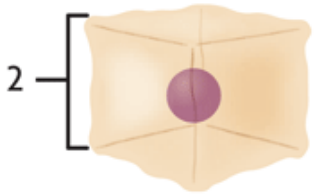
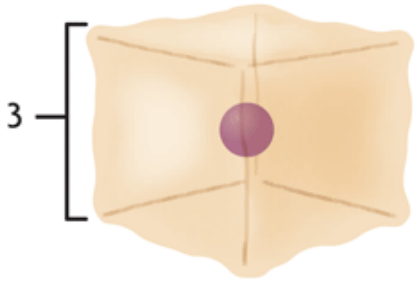
FIGURE 5.2 CELL DIVISION	
CELL TYPE	APPROXIMATE LIFE SPAN
Skin cell	2 weeks
Red blood cell	4 months
Liver cell	300–500 days
Intestine—internal lining	4–5 days
Intestine—muscle and other tissues	16 years

- Some cells are unlikely to divide (G_0).

5.1 The Cell Cycle

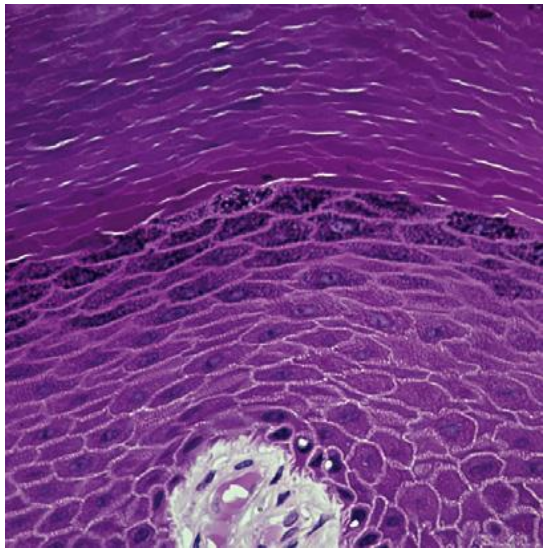
Cell size is limited.

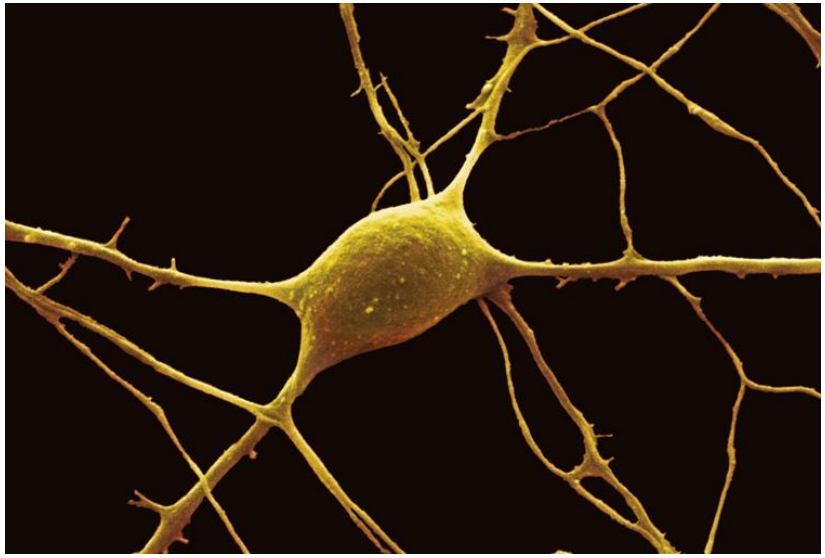
- Volume increases faster than surface area.

Relative size			
Surface area (length × width × number of sides)	6	24	54
Volume (length × width × height)	1	8	27
Ratio of surface area to volume	$\frac{6}{1} = 6{:}1$	$\frac{24}{8} = 3{:}1$	$\frac{54}{27} = 2{:}1$

5.1 The Cell Cycle

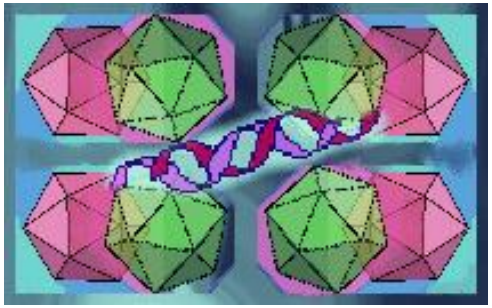
- Surface area must allow for adequate exchange of materials.
  - Cell growth is coordinated with division.
  - Cells that must be large have unique shapes.



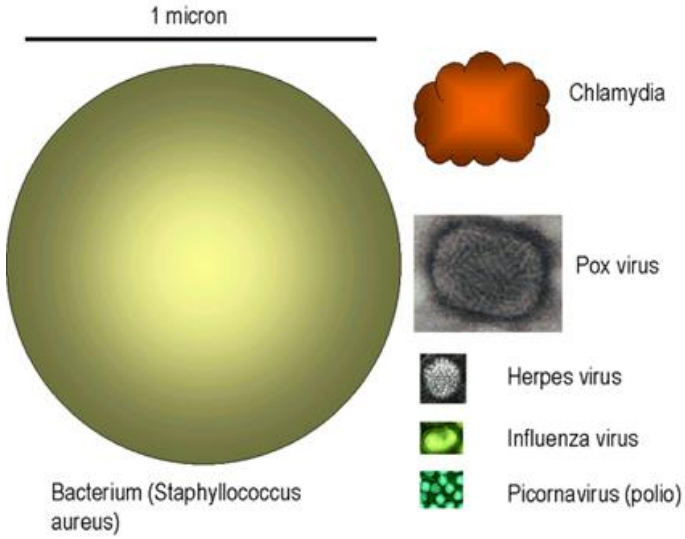


INTRODUCTION TO MEDICAL VIROLOGY

Lecturer dr. Abeer Saleh Hasan



Viruses: General Properties



1. Small size:

- The smallest infectious agents (20-300 nm in diameter)
- Bacteria (300-1000nm); RBC (7500nm)

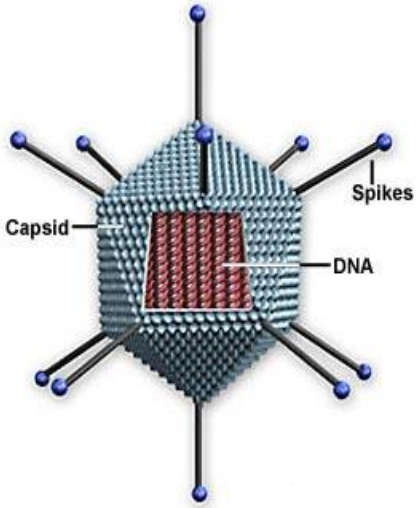
2. Genome:

- Either DNA or RNA

3. Metabolically inert:

- Do not posses active protein synthesizing apparatus
- Do not have a nucleus, cytoplasm, mitochondria or ribosomes
- No metabolic activity outside host: obligate intracellular parasites
- Can replicate only inside living cells; NOT on inanimate media

Viruses: Structure



- **Genome:**
  - A core of DNA or RNA
  - May be single-stranded (ss) or double stranded (ds)
  - May be circular or linear
- **Capsid:** protein coat surrounding the genome
  - Provides structural symmetry
  - Participates in attachment to susceptible host
  - Facilitates transfer of viral nucleic acid in to host cell
  - Protects the viral genome from nucleases in blood stream
- **Capsomeres:** the structural units making up capsid: consist of one or several proteins

Viruses: Structure

Other Viral Proteins

Outer viral proteins are **antigenic** and induce neutralizing antibodies and activate Tc cells to kill virus-infected cells. This ccurs in natural infections and immunization

Some virus proteins act as **superantigns** like EBV and CMV

Some viruses like HSV and CMV contain regulatory proteins located in **tegument** present between nucleocapsid and envelope

Viruses: Structure

Envelope:

- A lipoprotein surrounding the capsid in some viruses
- May contain material of host cell as well as viral origin.
- Virus-encoded glycoproteins are exposed on the surface of the envelope
- Most human helical viruses are enveloped while icosahedral are either enveloped or non-enveloped

Nucleocapsid

- The protein-nucleic acid complex

Virion

- The complete infective virus particle

Viruses: Structure

Significance of Envelope

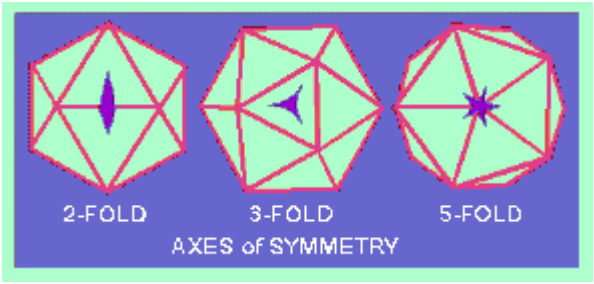
- Enveloped viruses are more unstable i.e. are more sensitive to heat, drying, detergents and alcohols
- All viruses transmitted by feco-oral route like HAV, poliovirus rotavirus are non-enveloped (those have to survive in environment)
- Enveloped viruses are often transmitted by direct contact as by blood, sexual contact like HIV, HBV, HCV, rabies virus, measels, mumps, rubella viruses etc

Viruses: Symmetry (Shapes)

1. Cubic Symmetry
(Icosahedral)

- Have exactly 60 subunits on the surface of an icosahedron

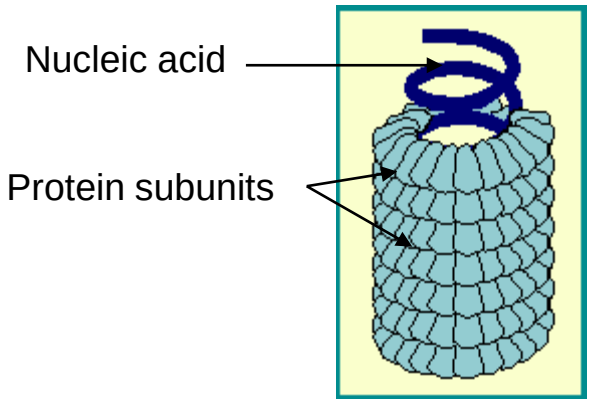
- Have fivefold, threefold and twofold rotational symmetry



Viruses: Symmetry (Shapes)

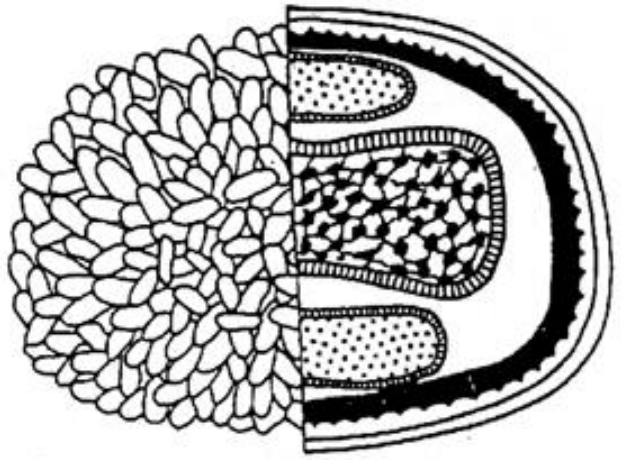
2. Helical Symmetry

- The virion contains an elongated nucleocapsid
- The capsomeres are arranged round the spiral of nucleic acid
- Most helical viruses are enveloped



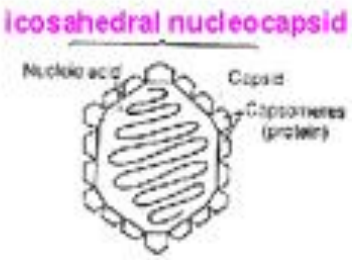
Viruses: Symmetry (Shapes)

- **3. Complex symmetry**
- Does not conform to cubic or helical symmetry

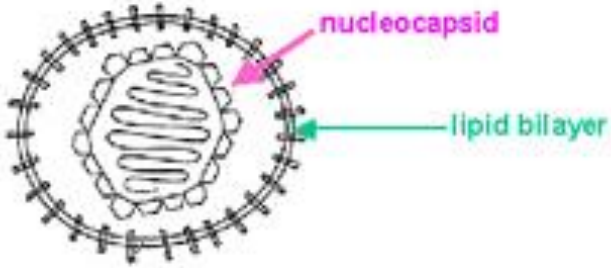


POXVIRUS FAMILY

5 BASIC TYPES OF VIRAL SYMMETRY

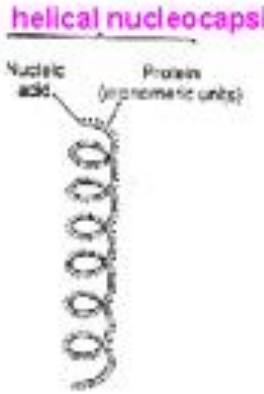


ICOSAHEDRAL

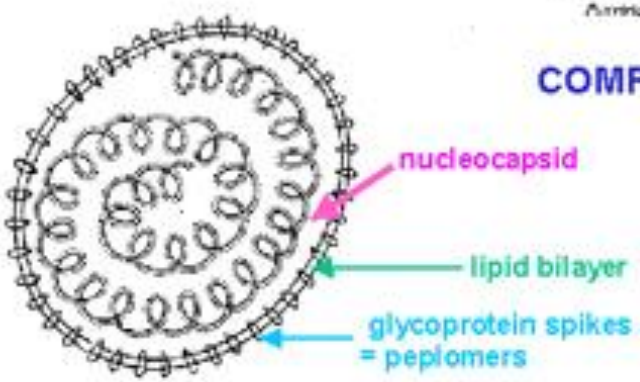


ENVELOPED ICOSAHEDRAL

COMPLEX



HELICAL



ENVELOPED HELICAL

Differences Between Different Groups of Microorganisms

	Growth on artificial media	Division by binary fission	Whether they have both DNA and RNA	Whether they have ribosomes	Whether they have mura mic acid	Their sensitivity to antibiotics
Bacteria	Yes	Yes	Yes	Yes	Yes	Yes
Mycoplasma	Yes	Yes	Yes	Yes	No	Yes
Rickettsia	No	Yes	Yes	Yes	Yes	Yes
Chlamydia	No	Yes	Yes	Yes	No	Yes
Viruses	No	No	No	No *	No	No

* The arenavirus family (an RNA virus family) appears to package ribosomes 'accidentally'. The packaged ribosomes appear to play no role in viral protein synthesis

Atypical Virus-like Agents

Defective Viruses

- Are composed of viral nucleic acid and proteins but cannot replicate without a ‘helper’ virus
- During growth many defective viruses are produced in addition to infectious viruses

Pseudovirions

- Contain host cell DNA instead of viral DNA within the capsid
- Can infect cells but do not replicate

Atypical Virus-like Agents

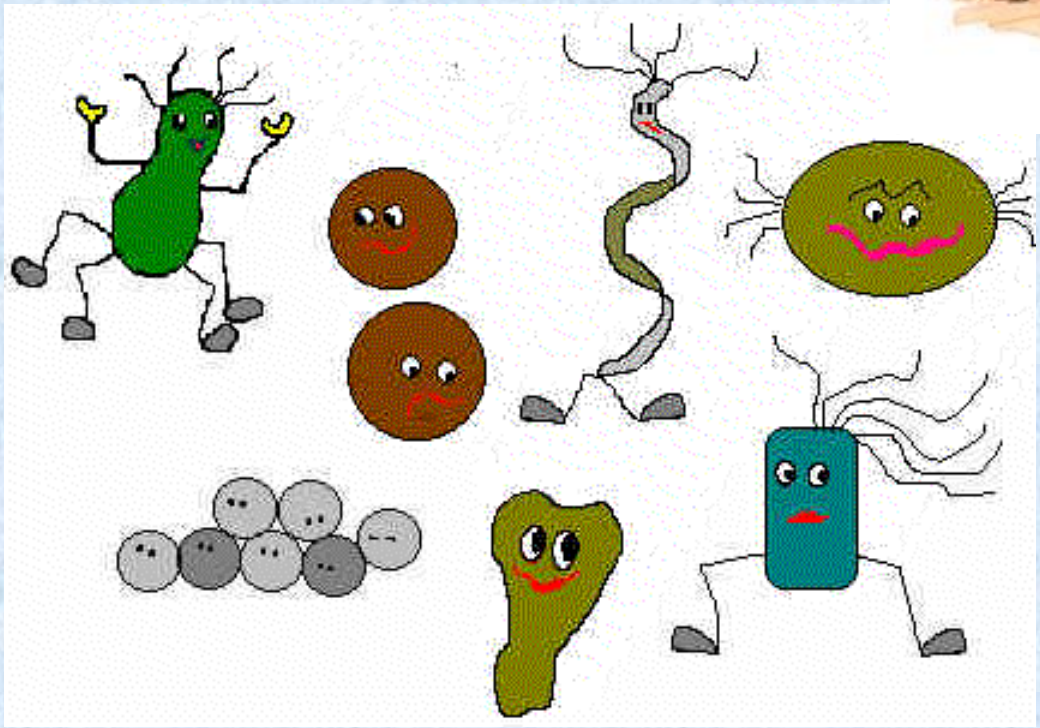
Viroids

- Consist solely of a single molecule of circular RNA without a protein coat or envelope
- RNA is small and does not code for any protein.
- Cause several plant diseases but are not implicated in human diseases

Prions

- Are infectious particles that are composed solely of protein and no detectable nucleic acid
- Are cause of certain slow diseases like Creutzfeldt-Jacob Disease (CJD) in human and scrapie in sheep

Bacteria



Two kingdoms of bacteria:

- Eubacteria – “true” bacteria
- Archaebacteria – oldest organisms on earth, live in extreme conditions

Bacteria are:

- Unicellular
- Prokaryotic…which means?

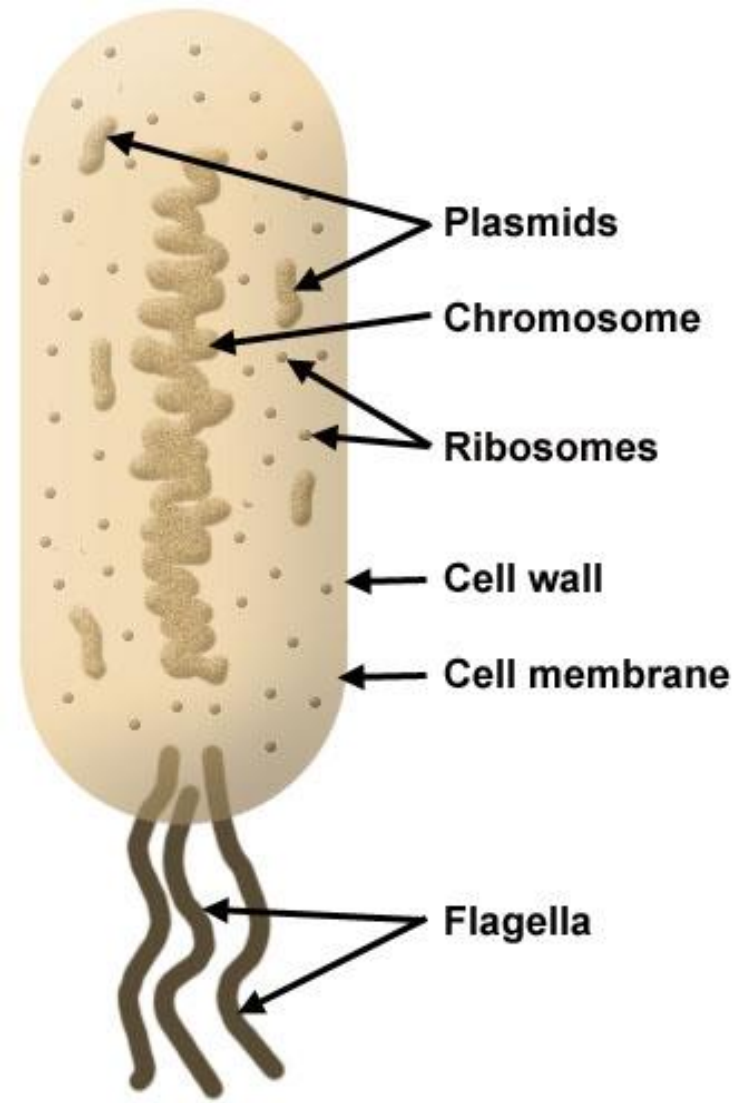
Fact: Each square centimeter of your skin averages about 100,000 bacteria. A single teaspoon of topsoil contains more than a billion (1,000,000,000) bacteria.

Bacteria Characteristics

- Some bacteria are aerobic, meaning that they require oxygen in order to survive. Other bacteria are anaerobes, meaning that they do not require oxygen to survive.
- Most bacteria are harmless and offer beneficial functions to living things and humanity.

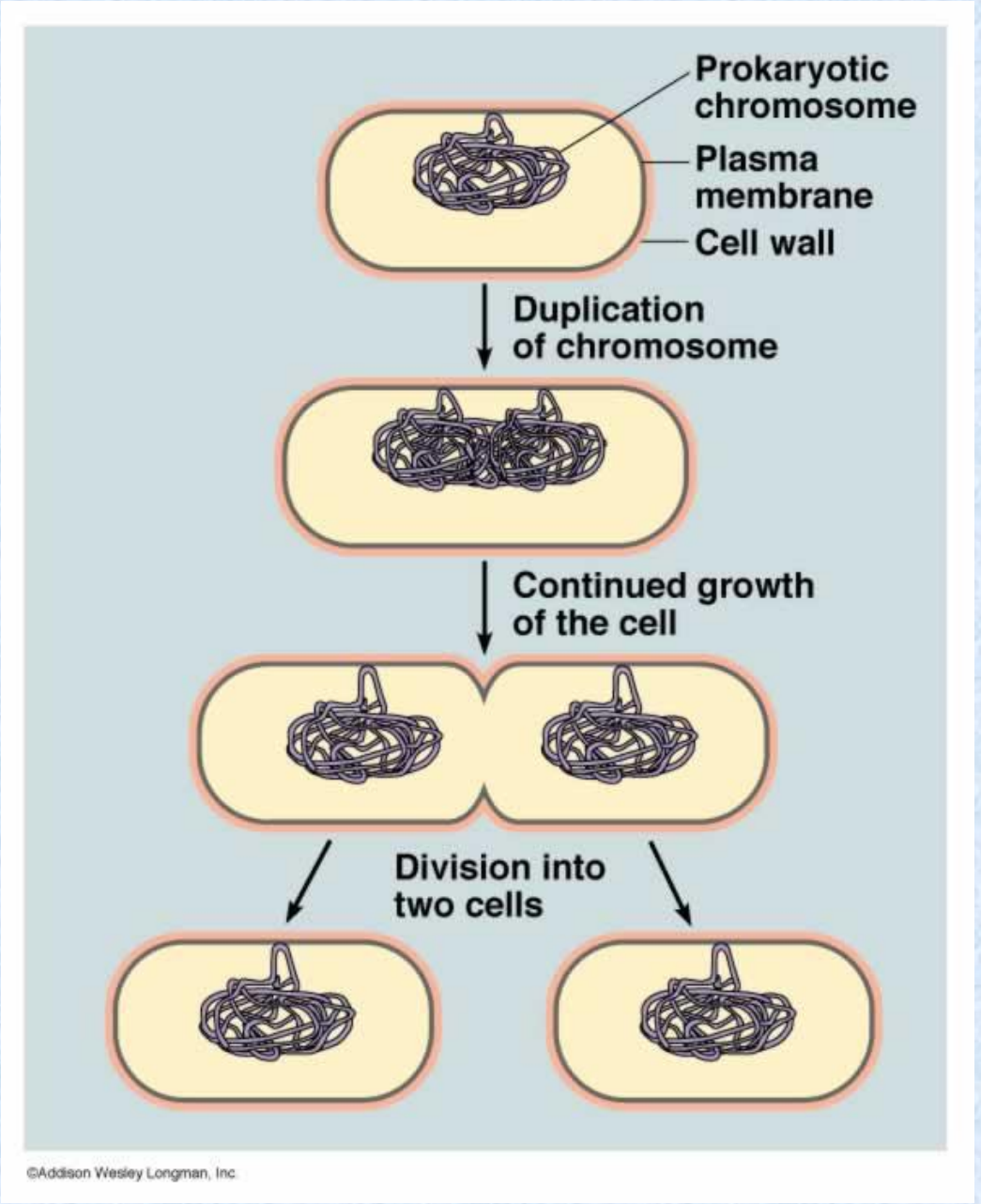
Bacteria contain:

- a singular, circular piece of DNA
- tiny circular pieces of DNA called plasmids
- ribosomes

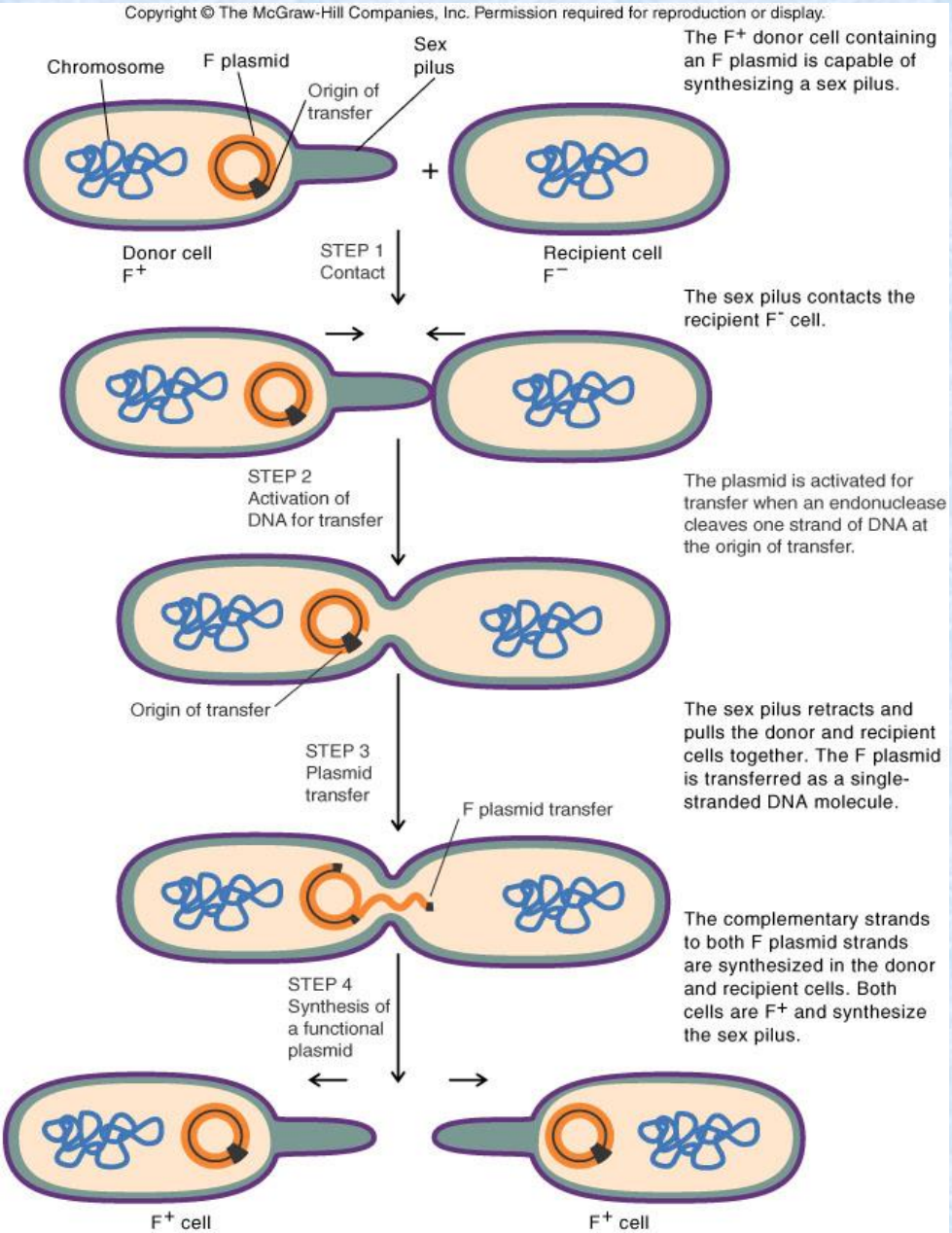


Bacteria reproduce:

Asexually (mitosis) using binary fission.



Bacteria reproduce:



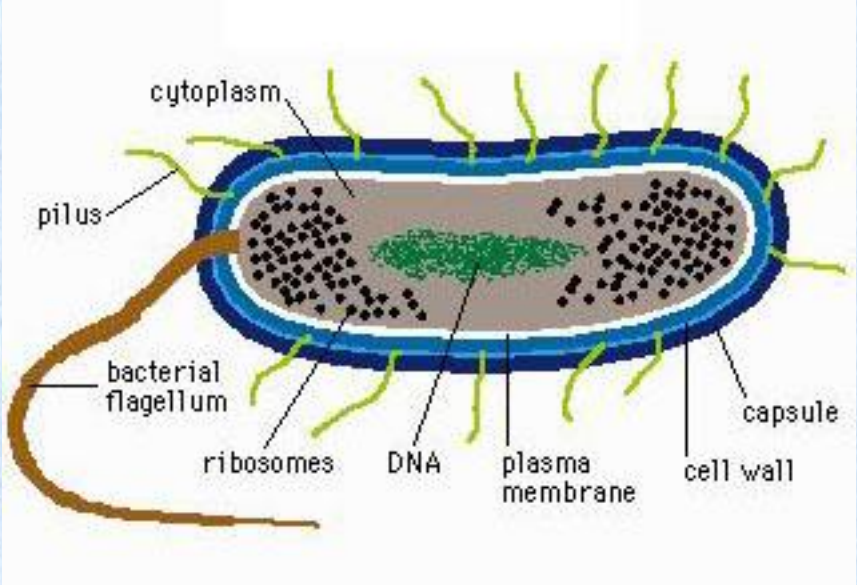
sexually using conjugation.

Bacteria exchange plasmid DNA.

This is how bacteria become antibiotic resistant.

Bacteria have cell walls made of:

- peptidoglycan (polysaccharide linked with chains of amino acids).
- this may be covered with an outer membrane of lipopolysaccharide (chain of sugar with a lipid attached).

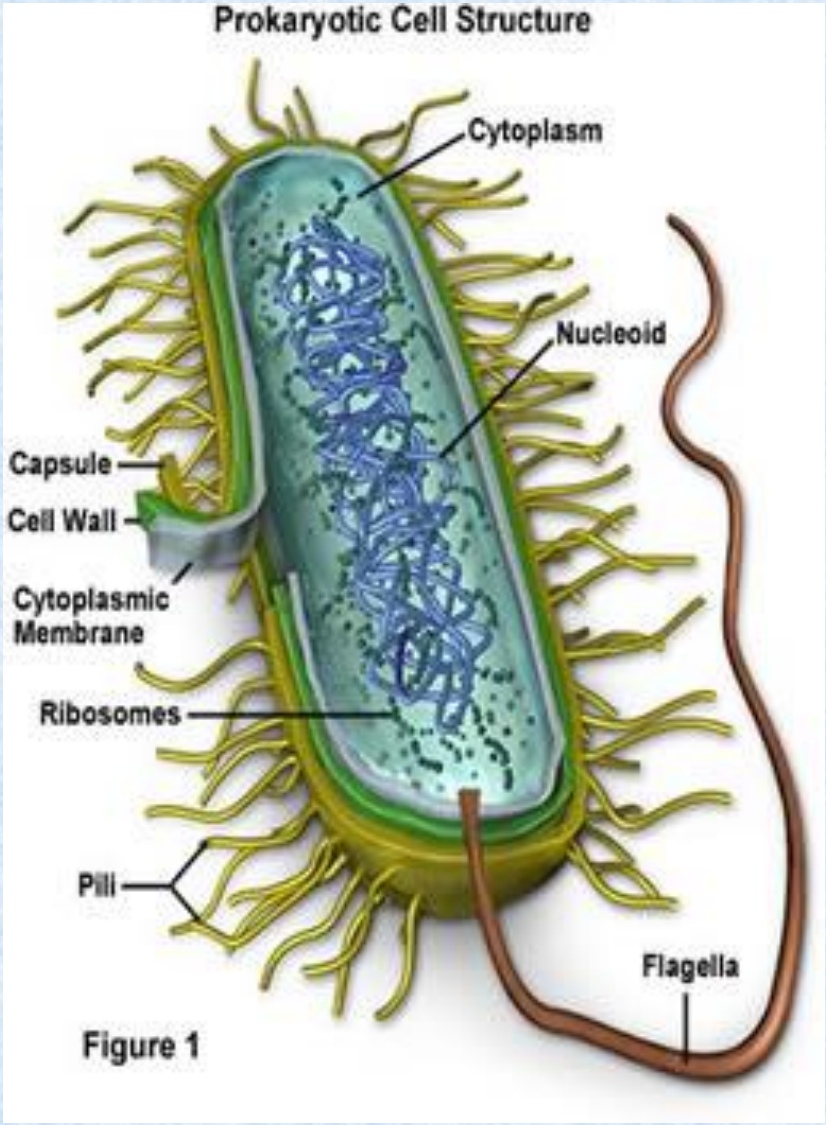


Some bacteria:

- have a gelatinous layer called a capsule surrounding the cell wall.
- form thick-walled endospores around chromosomes when they are exposed to harsh conditions (drought, high temperatures) - these types cause botulism

Some bacteria have:

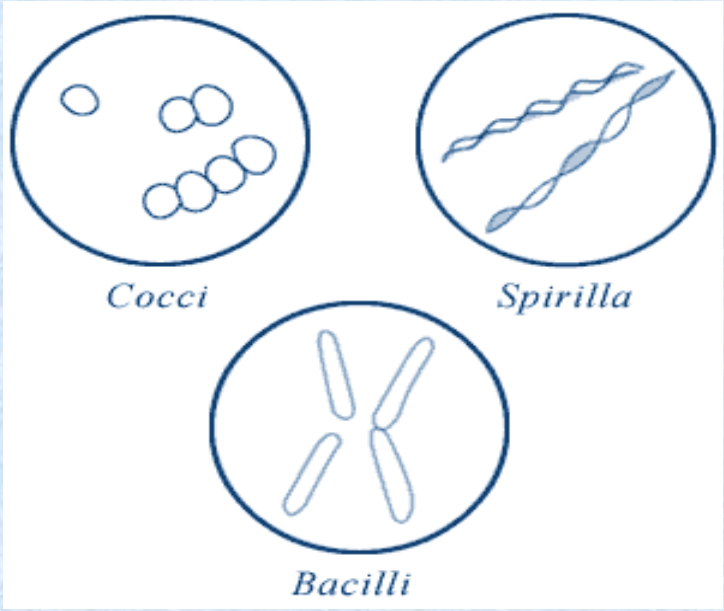
- flagella for locomotion.
- pili (short, thicker outgrowths that help cell to attach to surfaces)

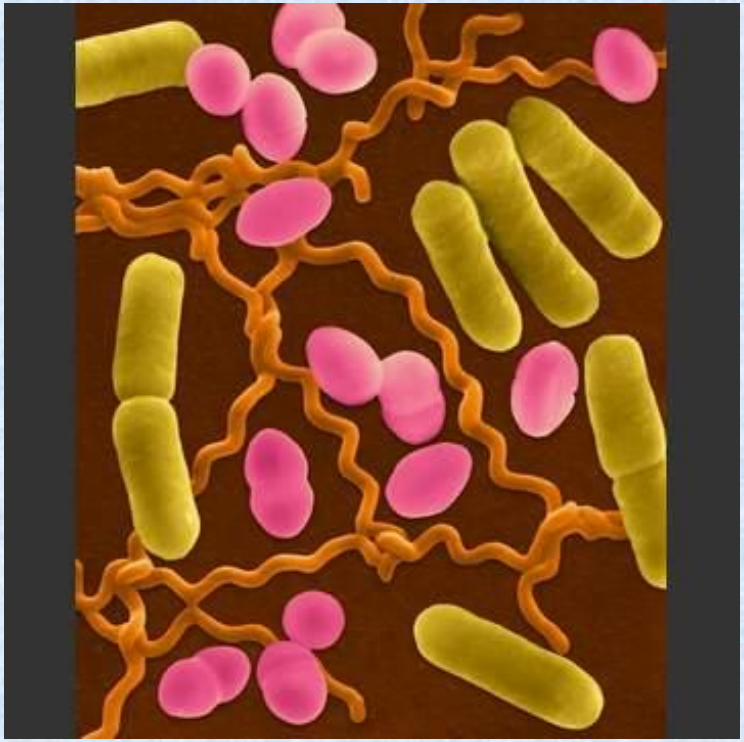


- Bacteria can be moved by air and water currents, and on any surface such as clothing, hands, or any object.

¨Three bacterial <u>shapes</u>:

1. Rod shaped are called bacillus(i)
2. Sphere shaped are called coccus(i)
3. Spiral shaped are called spirillum(I)





Gram stains:

- Important in medicine because provides information for treatment of bacterial disease.

- Bacteria stain either gram positive (purple) or gram negative (pink).
- Gram positive tend to respond to penicillin and like antibiotics.
- Gram negative respond to types of antibiotics unrelated to penicillin.

Gram Stain Process:

Crystal violet dye → **Iodine** →

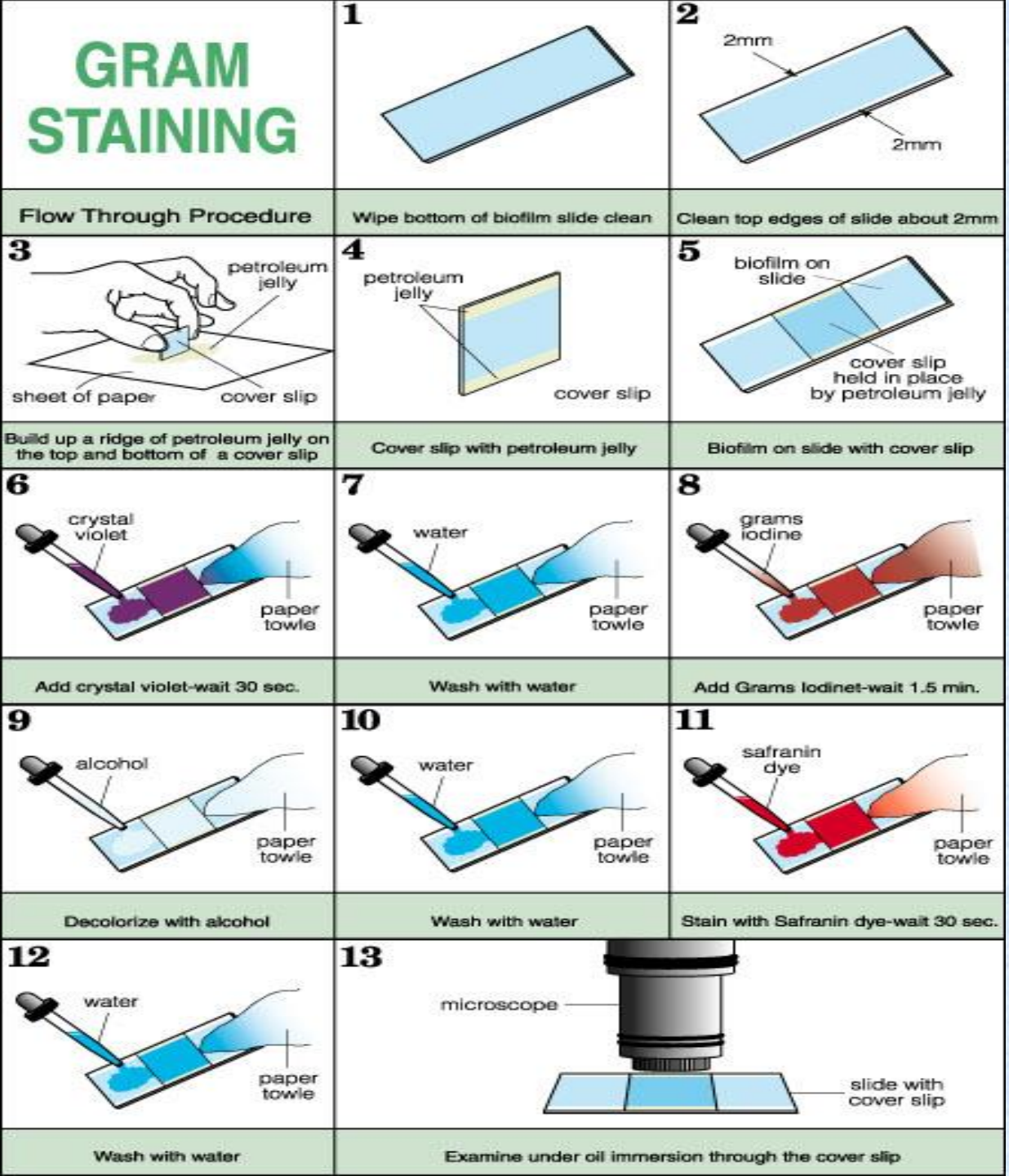
Purple

Decolorizes

Alcohol → **Safranin**

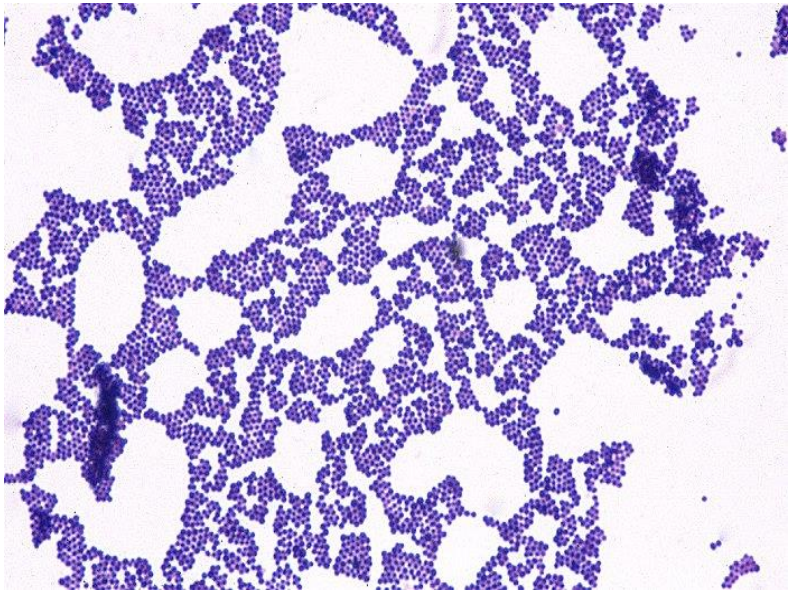
Pink

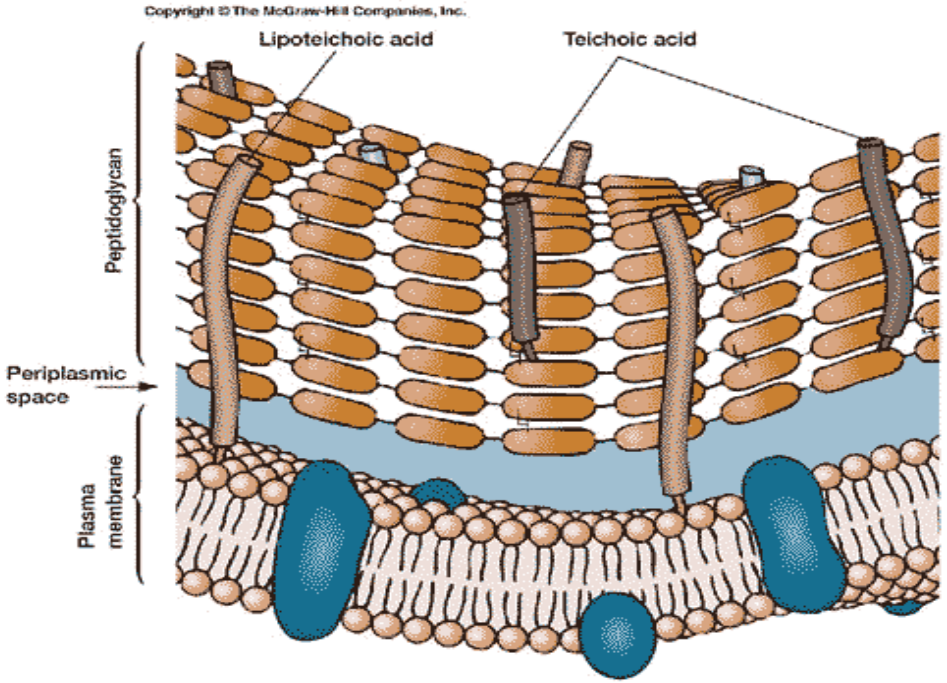
Counterstain



A Gram Stain is usually performed on a smear preparation that has been heat fixed. One function of fixation is to secure (fix) the cells to the slide.

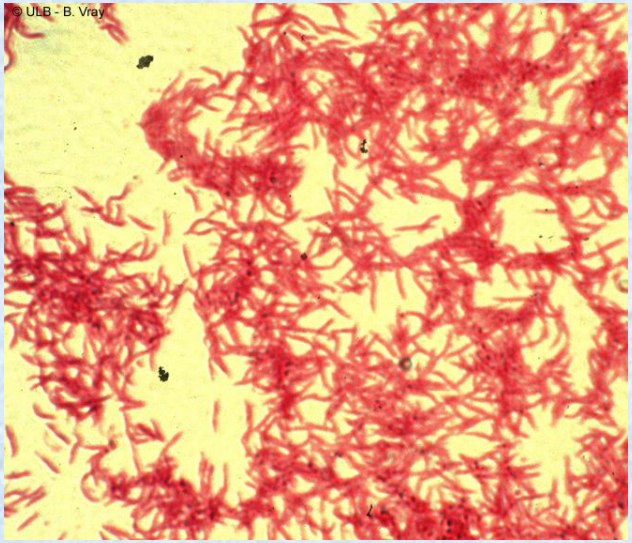
Gram positive = purple because of large amount of peptidoglycan in cell wall.

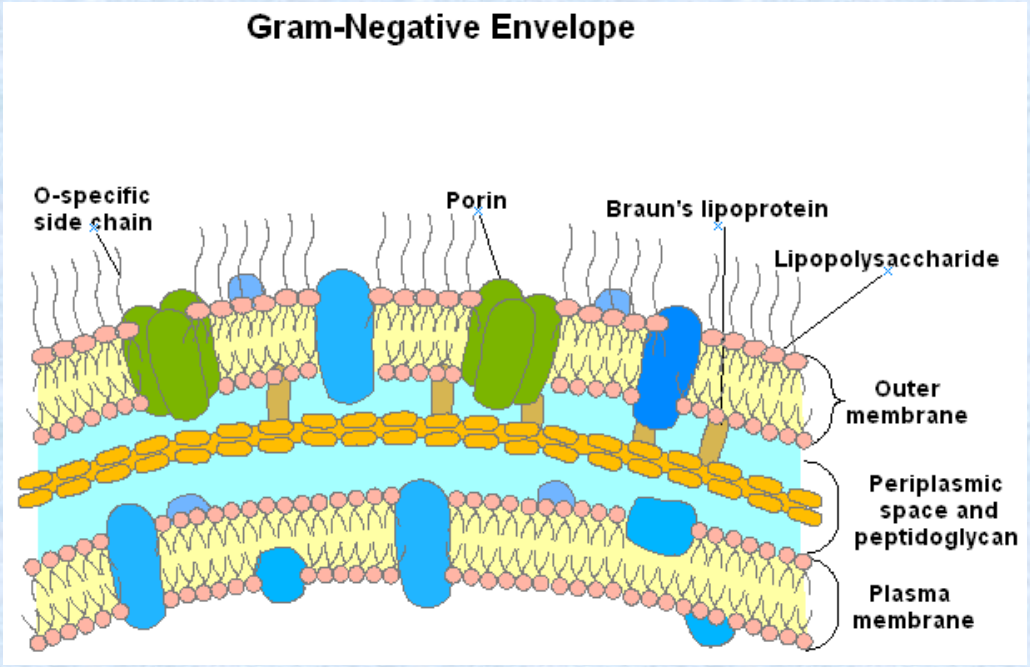




Polymer consisting of sugars and amino acids that forms a mesh-like layer outside the plasma membrane of eubacteria.

Gram negative = pink because¨ lipopolysaccharide membrane is removed by alcohol and thin peptidoglycan layer allows dye to escape.





(**LPS**) is a large molecule consisting of a lipid and a polysaccharide (carbohydrate) joined by a covalent bond.

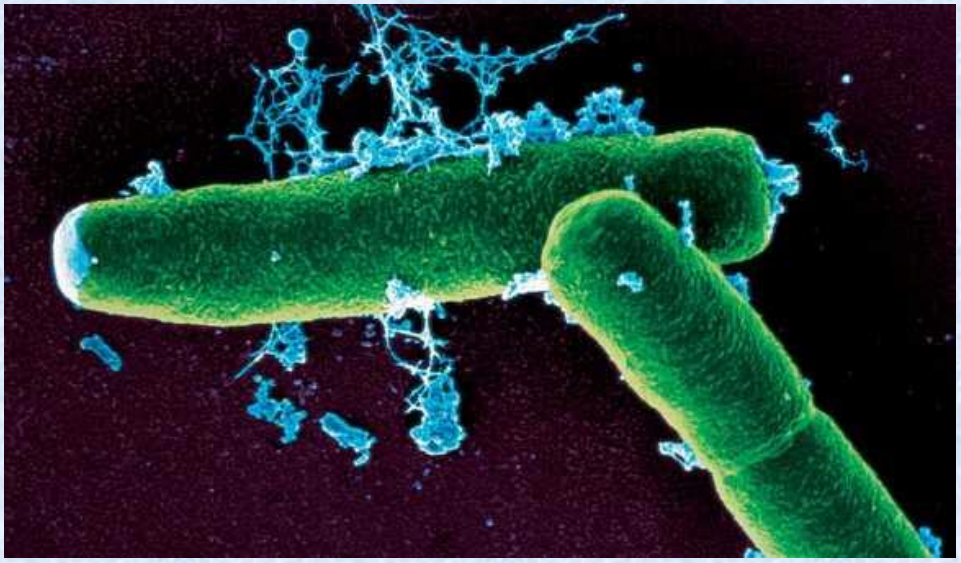
Antibiotics:

- work by preventing cell wall formation, breaking up cell membranes, or disrupting chemical processes.

- Antibiotics cannot treat viral infections.

There are three types of bacteria based on how they obtain energy: heterotrophs, photosynthetic, and chemoautotrophs.

This is the anthrax bacterium.

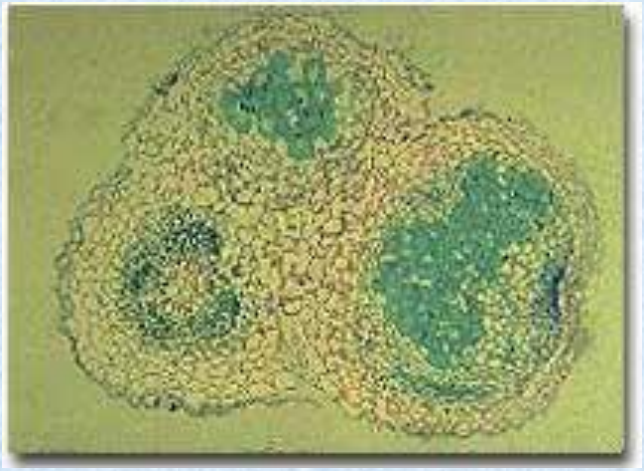


1. Most are heterotrophs:
    a. Decomposers – feed on and recycle organic material
    b. Pathogens – parasitic, disease-causing bacteria
        - Either attack cells or secrete toxins
    c. Nitrogen-fixing bacteria (*Rhizobium*)
        - Found in nodules of soybeans, peanuts, alfalfa, and clover
        - Convert atmospheric nitrogen (N_2) into ammonia, called nitrogen fixation.
        - Used in crop rotation

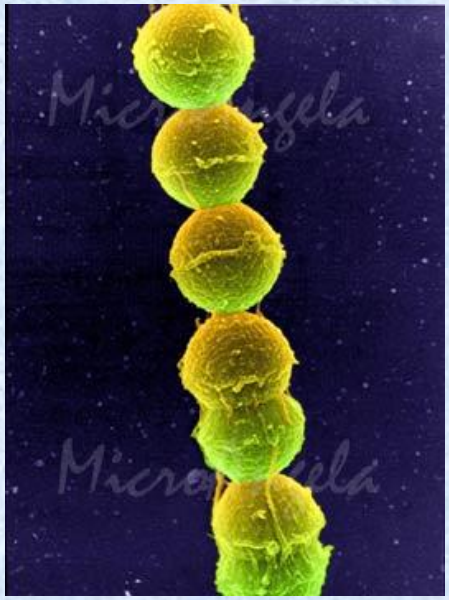
Decomposers

- Bacteria are decomposers, they break down the chemical elements inside other living or dead organisms. Some bacteria live in the intestines of humans and animals

Rhizobia bacteria convert nitrogen gas into other substances that help plants grow.



Pathogens



Streptococcus

Staphylococcus

Strep throat

***Staph* AND *Streptococcus* species**

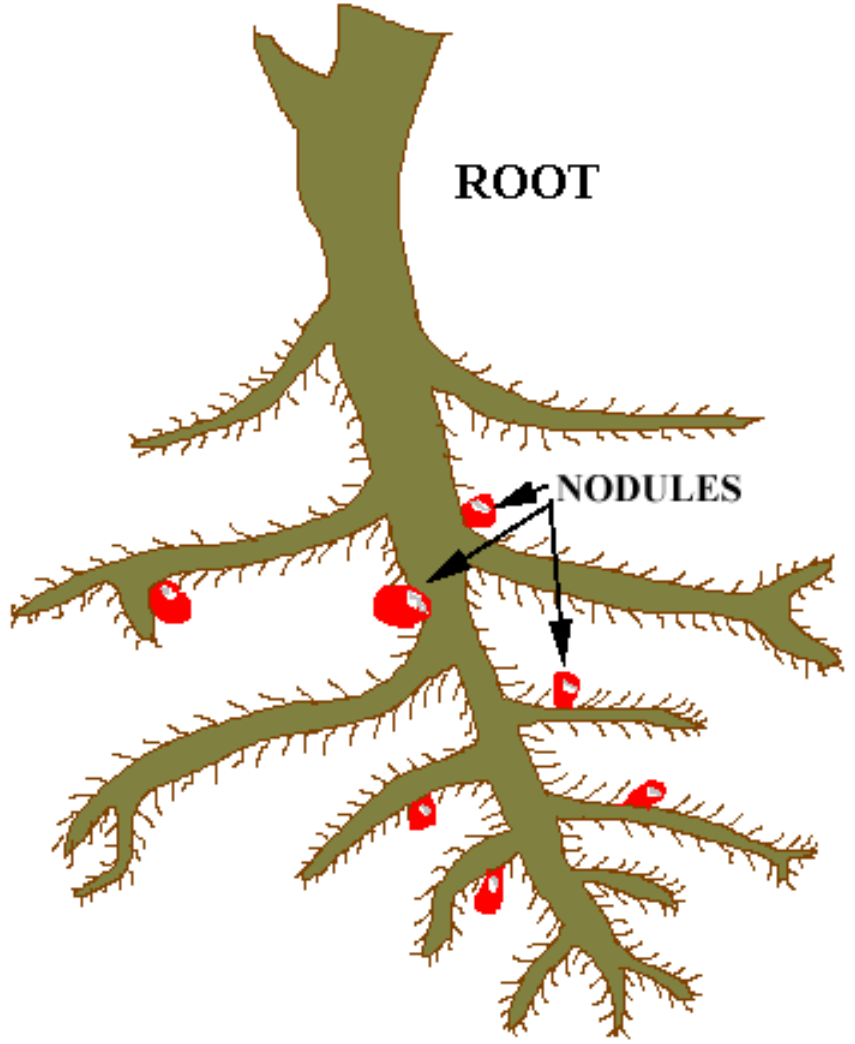
Impetigo: face, light skin

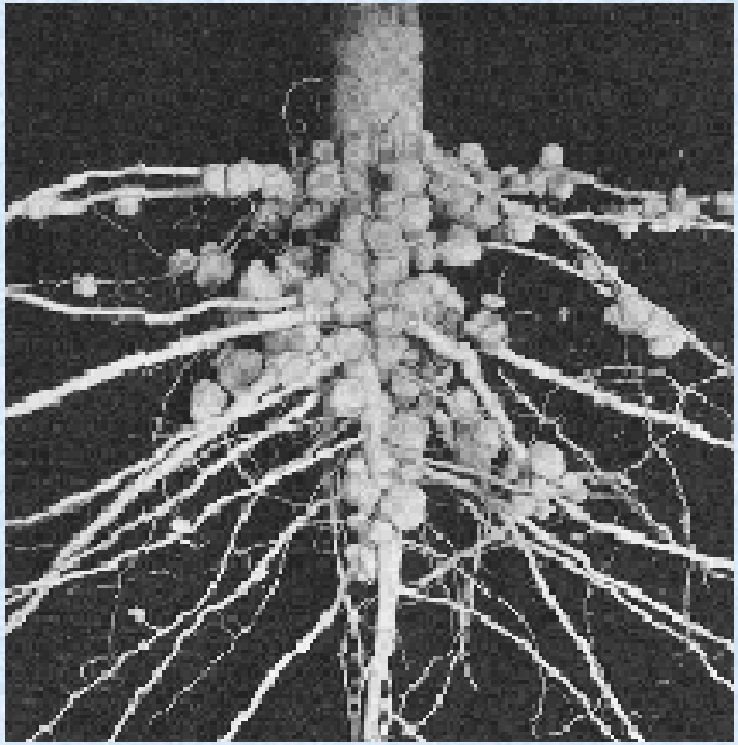
Fascitis: face, light skin

Necrotizing Fascitis: light skin, left; (especially important *Strep.* problem)

Cellulitis: lower legs, dark skin, right

Nitrogen-fixing bacteria (*Rhizobium*)



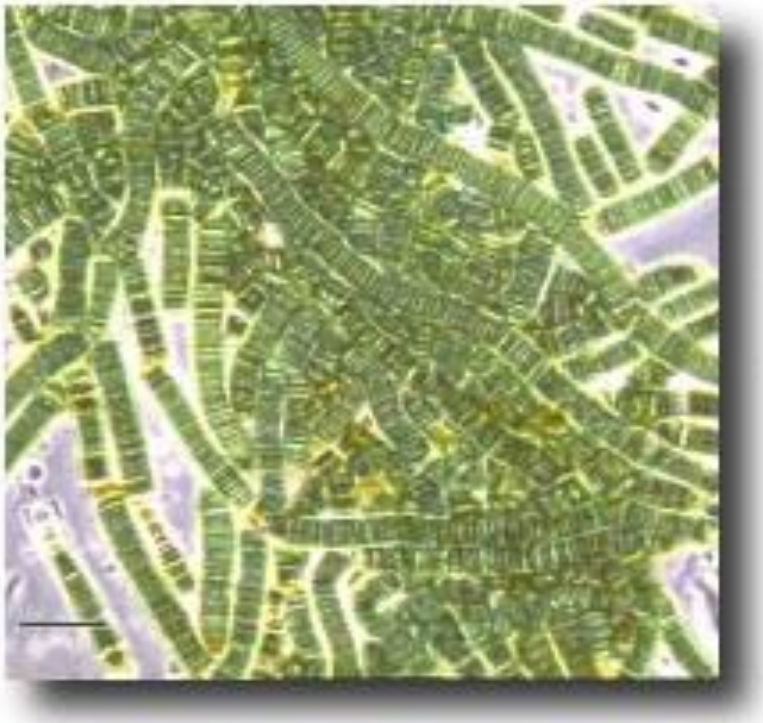


Nitrogen fixing bacteria in the nodules of roots

2. Some, like *Cyanobacteria*, are photosynthetic.

- These are autotrophs that use the sun's energy to make food.

This bacteria has chlorophyll and uses the process of photosynthesis to produce food very much like a plant.



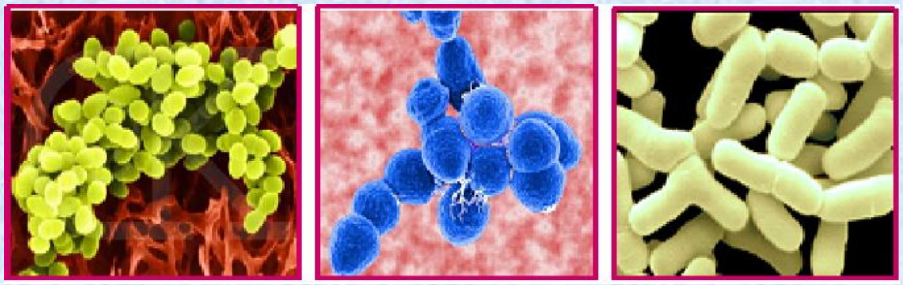
3. Chemoautotrophs

- Obtain energy by removing electrons from inorganic molecules such as ammonia and methane to make food.

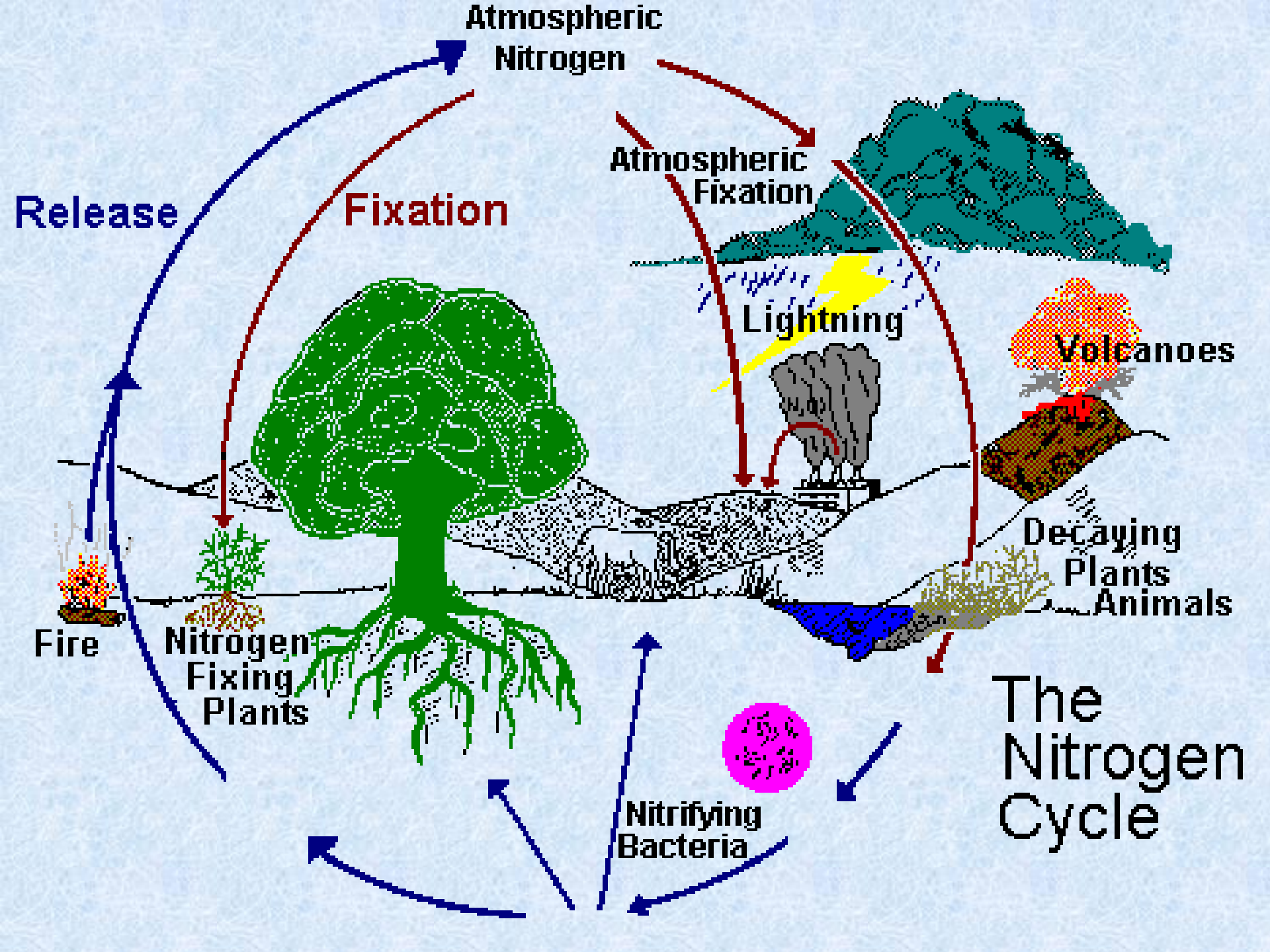
- Examples: *Nitrobacter* and *Nitrosomonas*
  - live in soil
  - have a crucial role in nitrification (turn ammonia into nitrates, the form of nitrogen commonly used by plants).

Some Good Bacteria

- **Lactic acid bacteria** have been used to ferment or culture foods for at least 4000 years.
- Examples: products like **yogurt and cheese**



- **Wastewater bacteria** feed on everything from solid human waste matter to last night's leftovers. As the bacteria eat, they convert organic matter to carbon dioxide, releasing electrons, the basic element of electrical current.


Atmospheric Nitrogen
Release
Fixation
Atmospheric Fixation
Lightning
Volcanoes
Decaying Plants Animals
Fire
Nitrogen Fixing Plants
Nitrifying Bacteria
The Nitrogen Cycle

GRAM'S STAINING

Presented by – Gurjeet Kaur

Hans Christian Gram

The Gram stain was devised by the Danish physician, **Hans Christian Gram, while working in Berlin in 1883. He later published this procedure in 1884.**

Gram's Stain

Gram staining (or **Gram's method**) is a method of differentiating bacterial species into two large groups

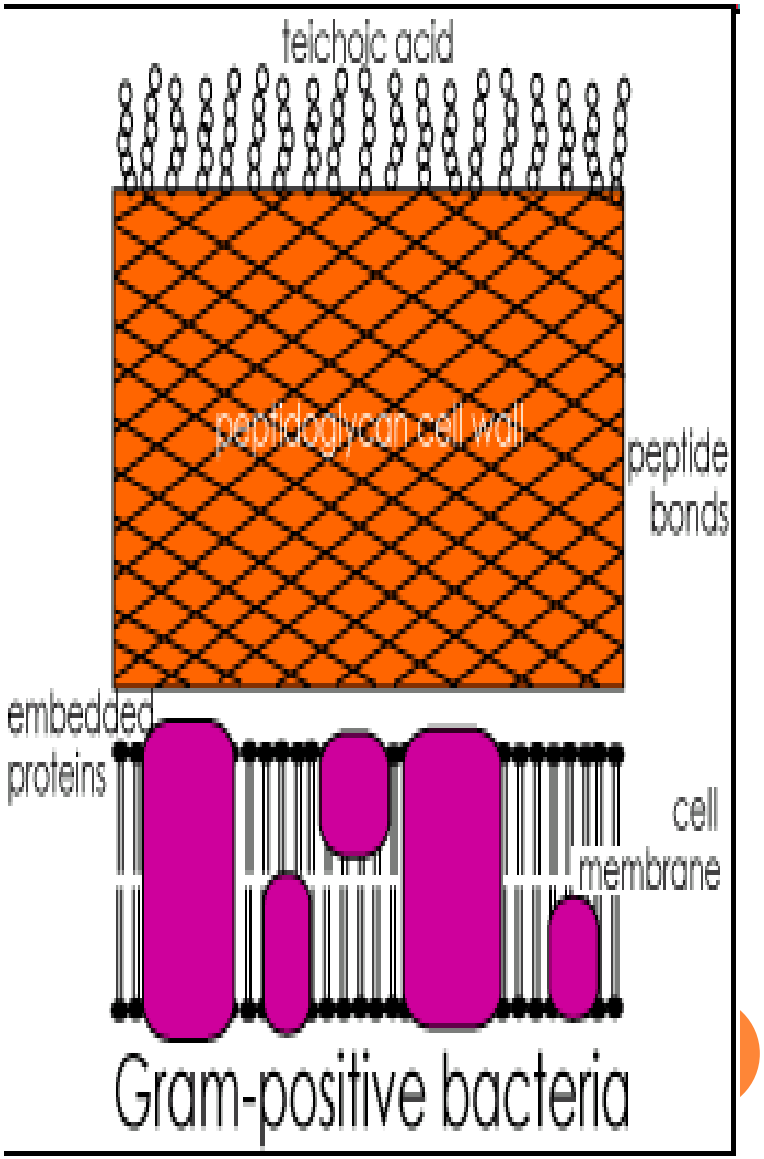
Gram Positive

Gram Negative

Gram staining differentiates bacteria by the chemical and physical properties of their cell walls.

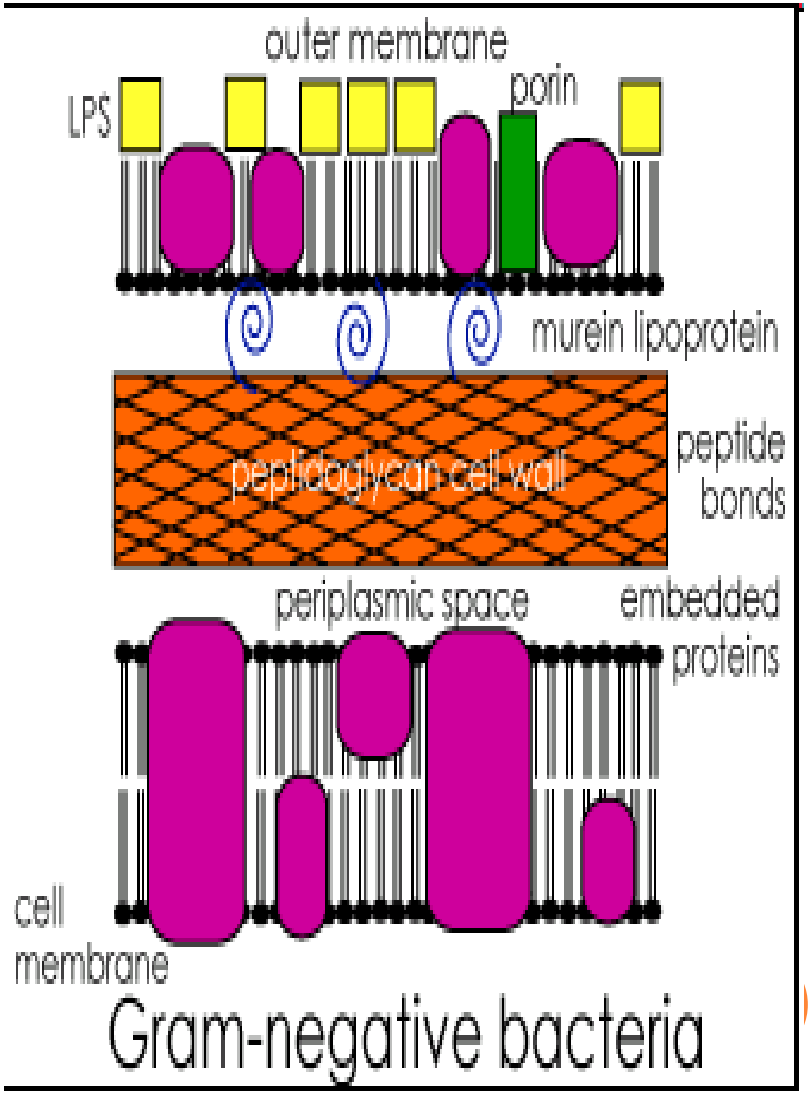
Gram Positive Bacteria

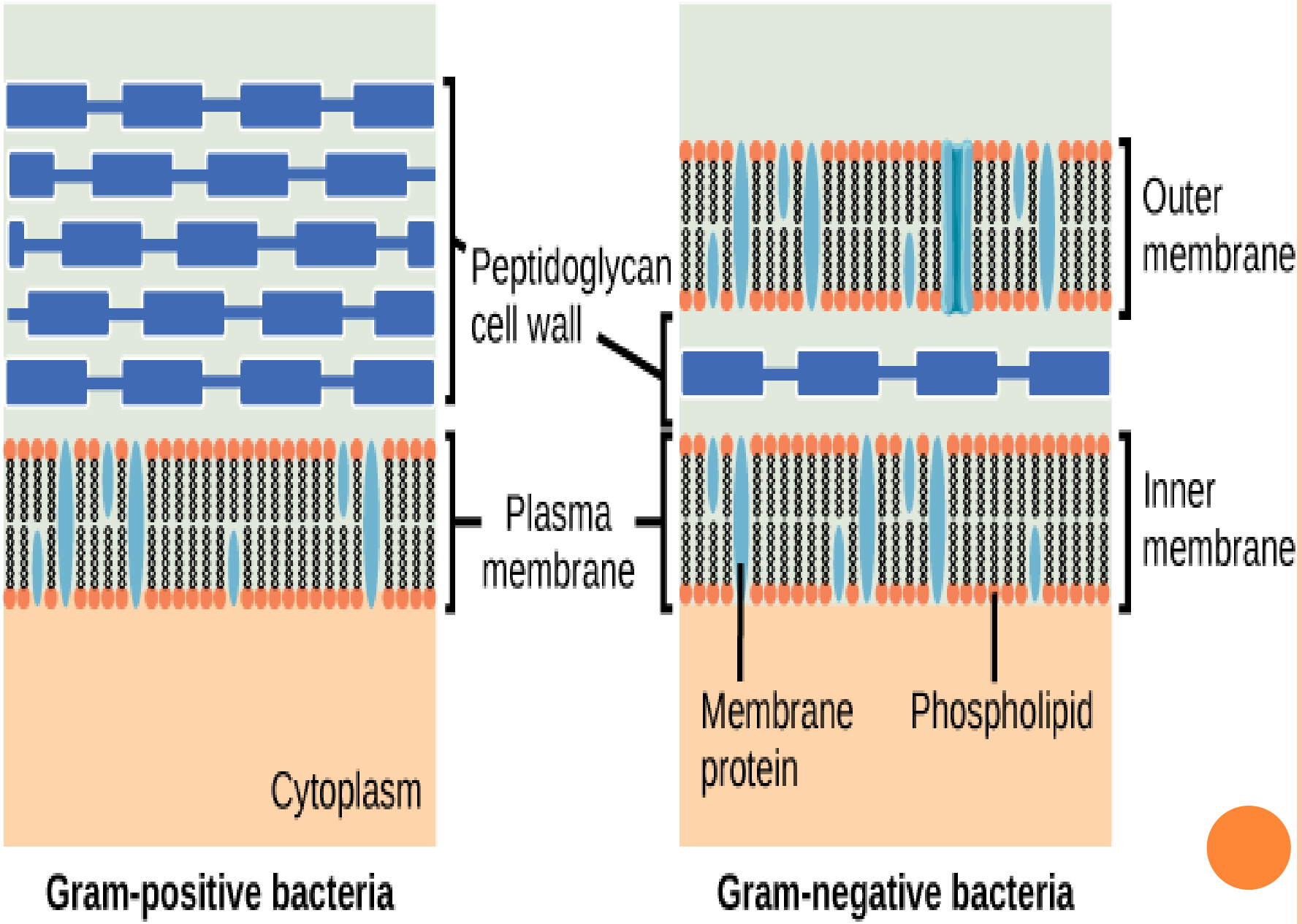
- Gram positive bacteria have a thick cell wall of peptidoglycan.
- Peptidoglycan is a polymer consisting of sugar amino acids that form a mesh like outside the plasma membrane of bacteria forming cell wall.
- In Gram positive bacteria, between the cell wall and cell membrane, there is a "membrane teichoic acid".



Gram Negative Bacteria

Gram negative bacteria have an outer membrane of phospholipids and bacterial Lipopolysaccharides outside of their thin peptidoglycan layer. The space between the outer membrane and the peptidoglycan layer is called the periplasmic space.




Peptidoglycan cell wall
Plasma membrane
Cytoplasm
Outer membrane
Inner membrane
Membrane protein
Phospholipid
Gram-positive bacteria
Gram-negative bacteria

Principle Of Gram's Staining

- The structure of the organism 's cell wall determines whether the organism is gram positive or negative.
- When stained with a primary stain and fixed by a mordant, some bacteria are able to retain the primary stain by resisting declorization while other get decolorized by decolorizer.
- Those bacteria which retain the primary stain are called Gram positive.
- Those bacteria which get decolorized and then get counterstained are called Gram negative.

1. Crystal violet - all bacteria take crystal violet- so all appears violet.

2. Iodine – Crystal Violet-iodine(CV-I) complex is formed.

3. Acetone- bacteria with high lipid content loose CV-I complex(appear colourless) but bacteria with less lipid content retains CV-I complex (appear violet).

4. Safranine/ basic fuchsin – only colourless bacteria takes – appear pink.


HIMEDIA
K001-1KT
1Kit
Gram Stains-Kit
HIMEDIA
Gram's Iodine

PROCEDURE

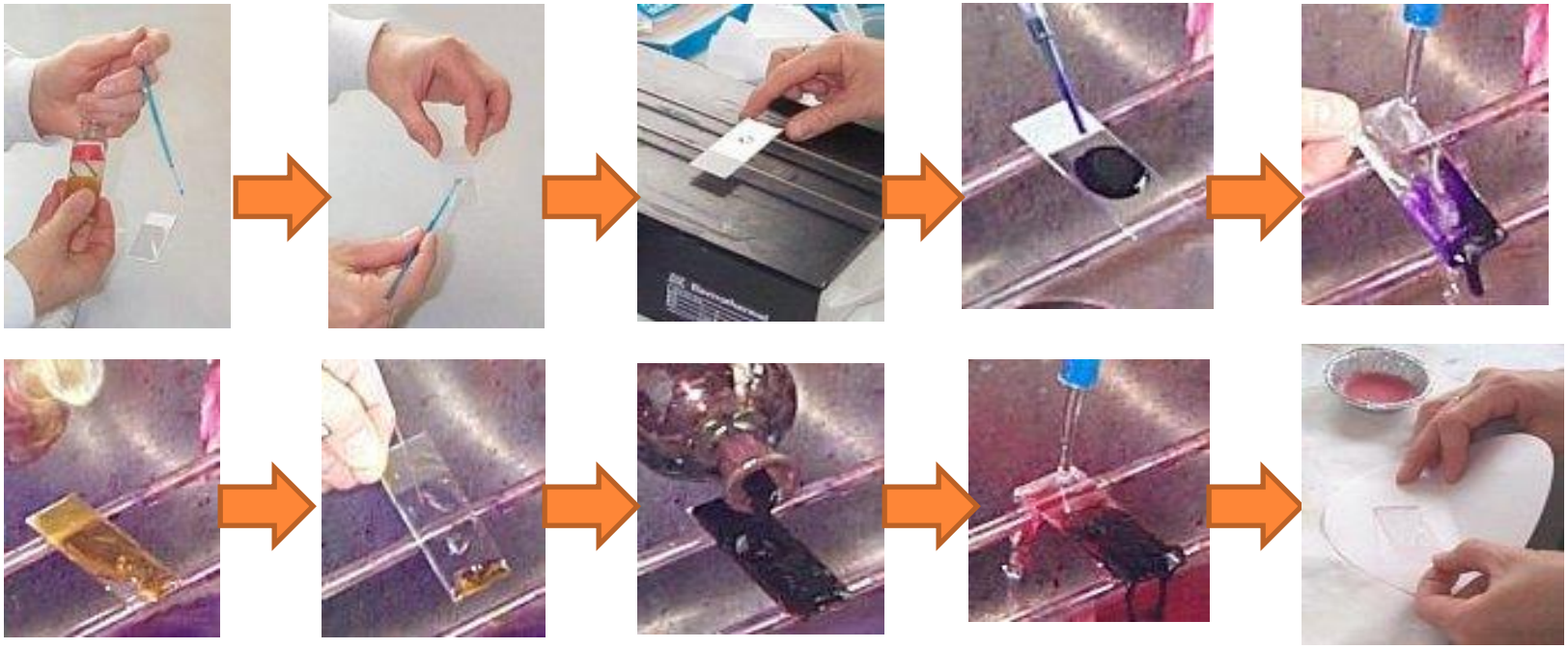
1. Make a smear & dry thoroughly in cool air. Fix the dried film by passing it briefly through a bunsen flame.

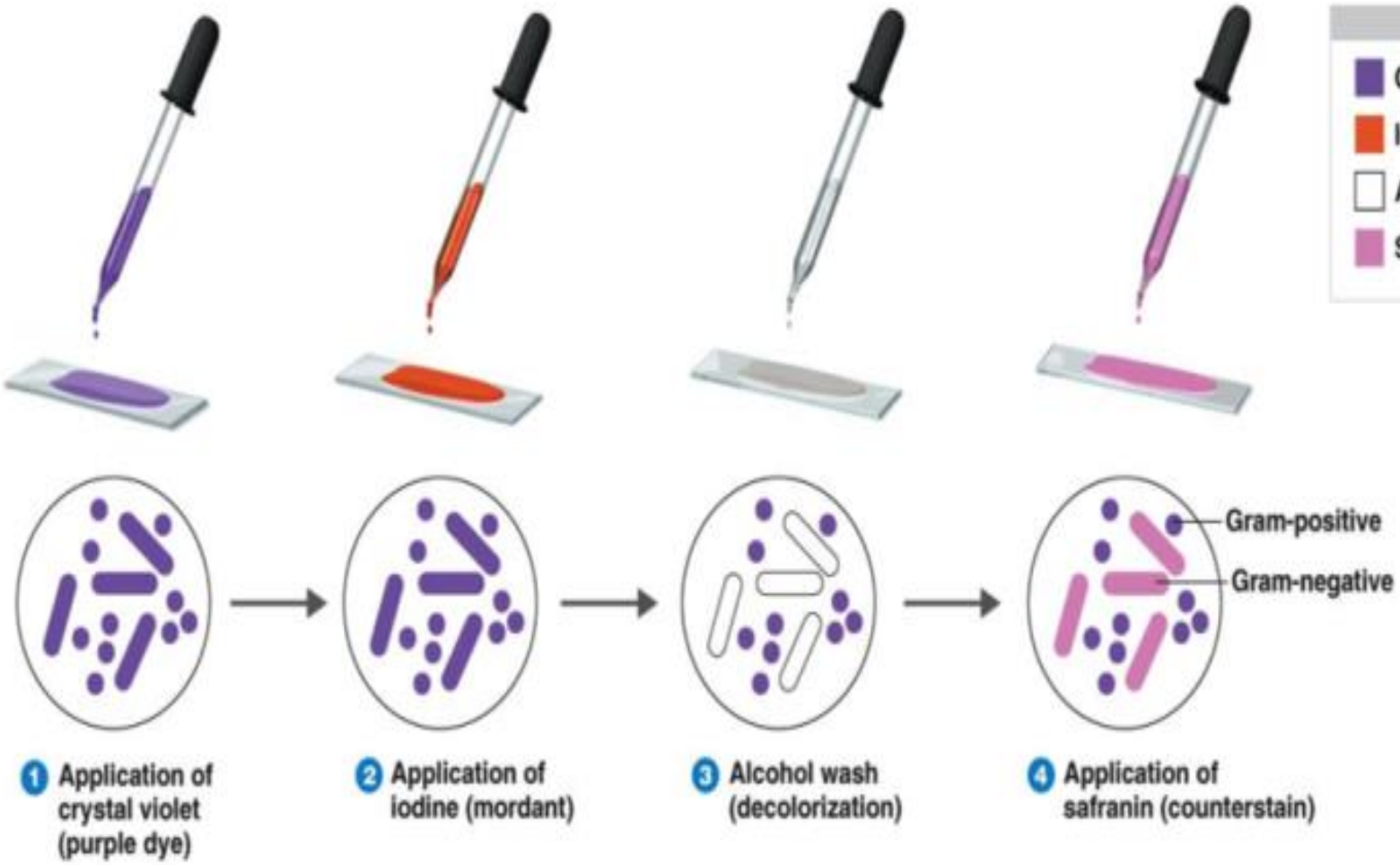
2. Flood the slide with crystal violate sol. for upto 1 min. Wash off briefly with tap water & drain.

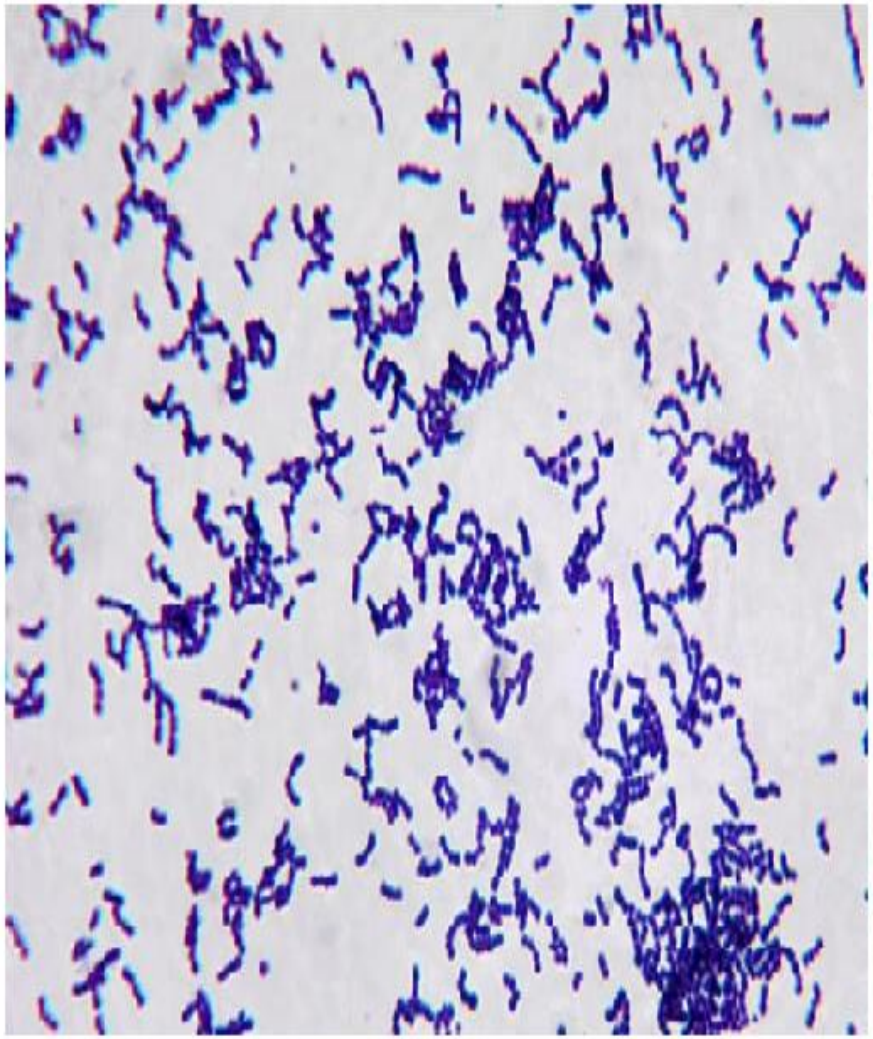
3.Flood the slide with gram's iodine sol. & allow to act as a mordant for about 1 min. Wash off with tap water & drain.

4.Decolourise the smear with acetone for 10-30 sec. taking care not to overdecolourise & immediately wash off with water.

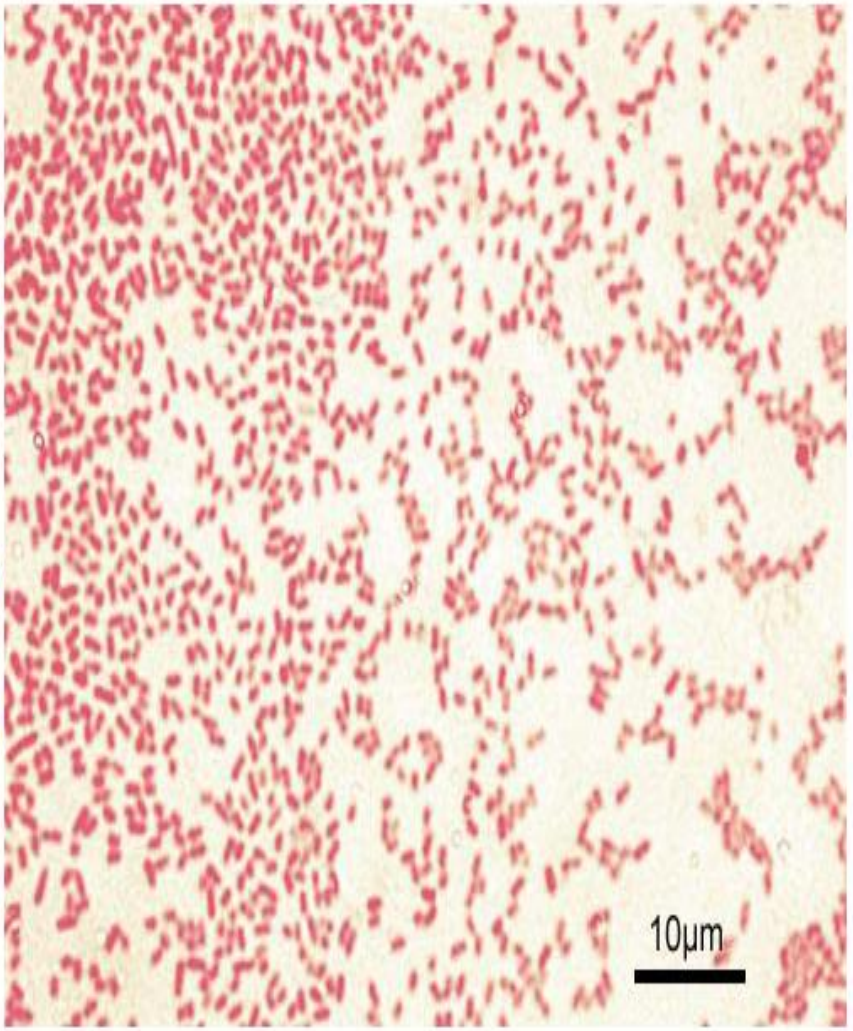
5.Flood the slide with safranin sol. & counterstain for about 30 sec, wash off with tap water, drain & blot dry with filter paper & examine under oil immersion objective.




KEY
Crystal violet
Iodine
Alcohol
Safranin
Gram-positive
Gram-negative
1 Application of crystal violet (purple dye)
2 Application of iodine (mordant)
3 Alcohol wash (decolorization)
4 Application of safranin (counterstain)

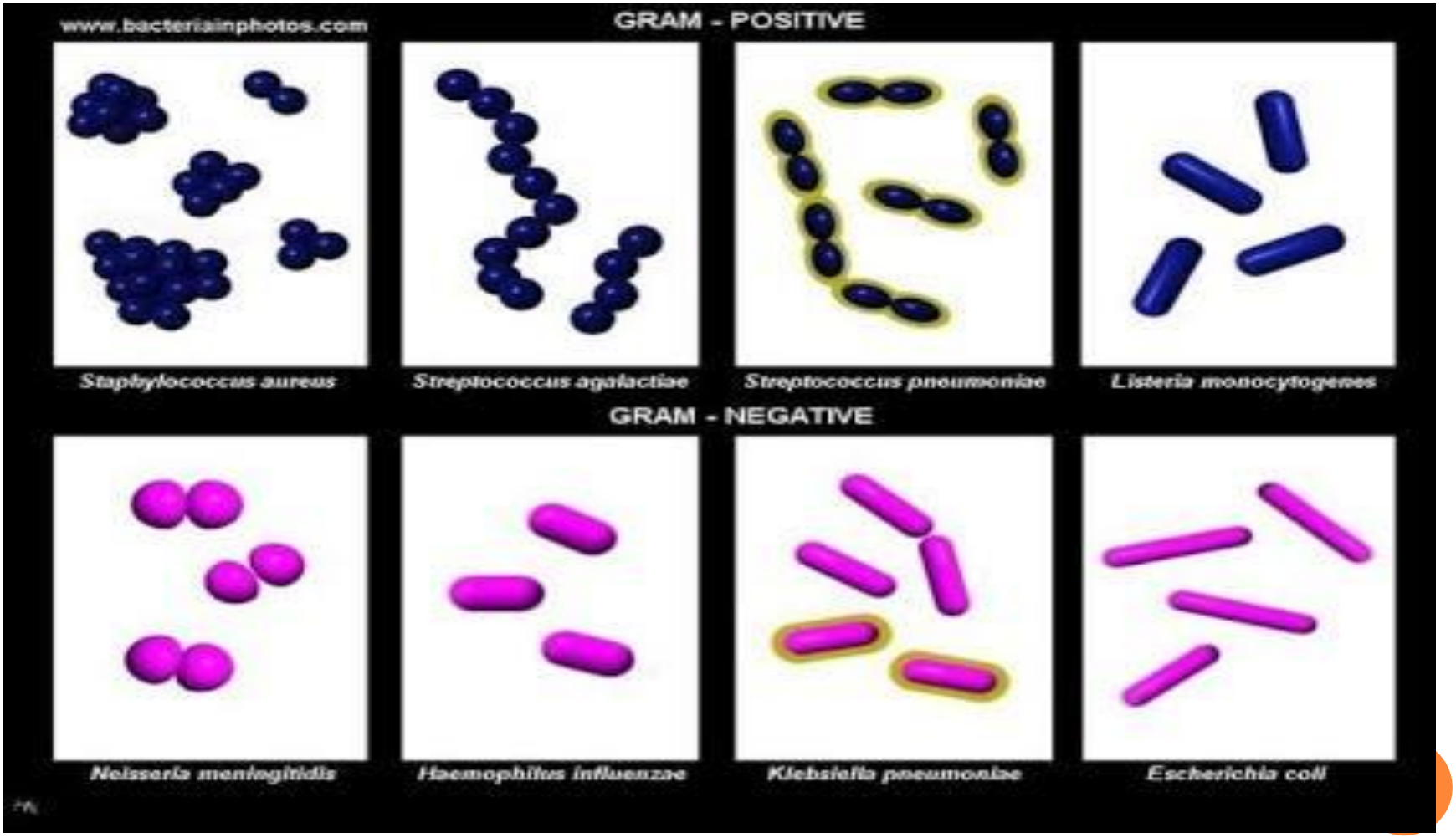


Gram Positive Bacteria



Gram Negative Bacteria

EXAMPLES


www.bacteriainphotos.com
GRAM - POSITIVE
Staphylococcus aureus
Streptococcus agalactiae
Streptococcus pneumoniae
Listeria monocytogenes
GRAM - NEGATIVE
Neisseria meningitidis
Haemophilus influenzae
Klebsiella pneumoniae
Escherichia coli

Thank You

The Cell Cycle

Dr . Abeer Saleh Hasan
Phd in clinical biochemistry

Why do cells divide?

- For growth and repair
- To get food, water, and waste in and out of our bodies quickly

What is the Cell Cycle?

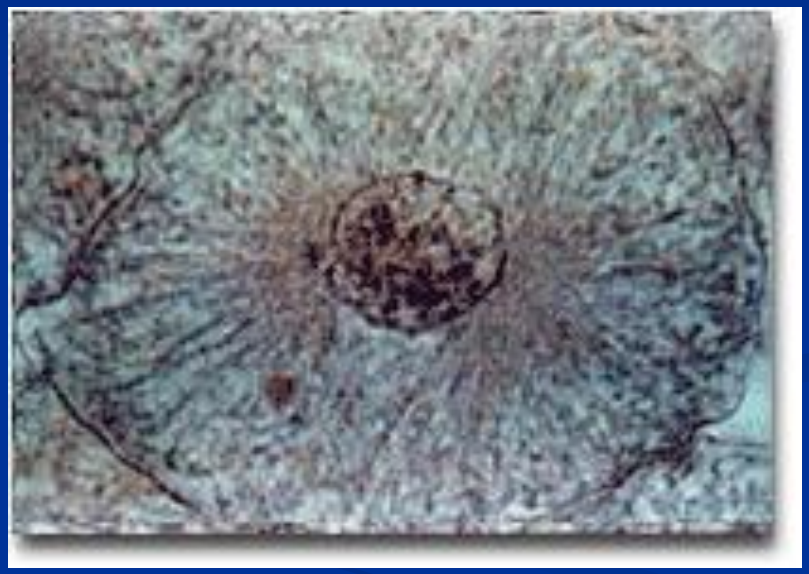
- Series of events that take place from one cell division to the next
- Constantly repeated

Three Stages of the Cell Cycle

- Interphase
- Mitosis
- Cytokinesis

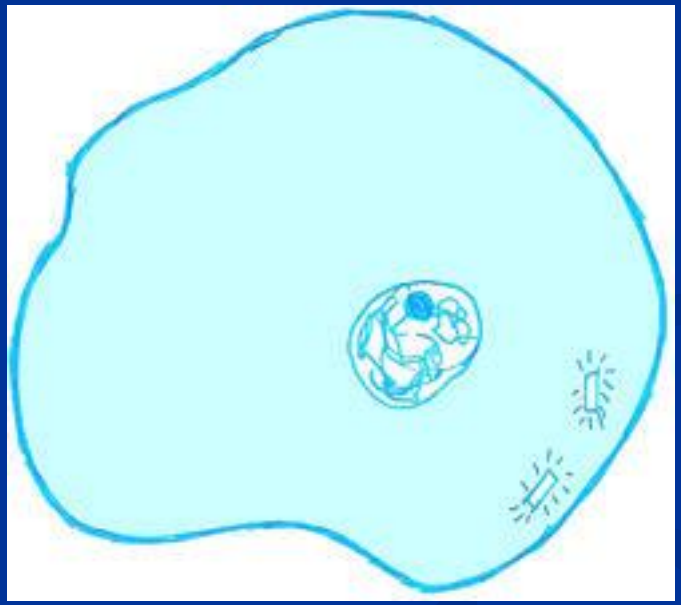
Interphase

- Period of growth and development
- Longest phase of the cell cycle
- Some cells never leave interphase such as nerve and muscle cells



Three things happen during interphase:

- Cell grows in size; makes an extra set of structures
- Cell makes a copy of its hereditary material. (DNA)
- Produces structures needed division (spindle fibers, centrioles)

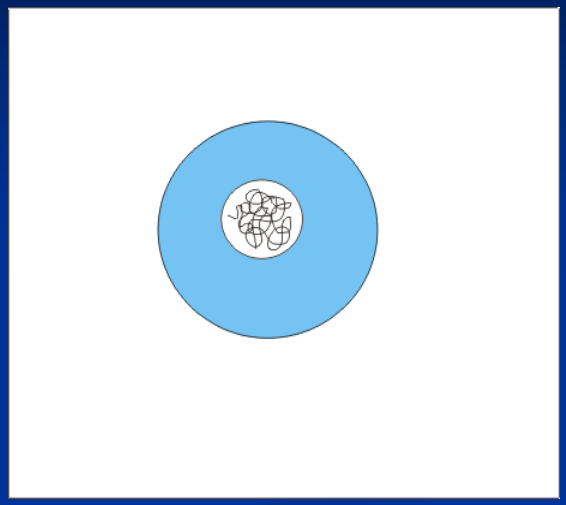


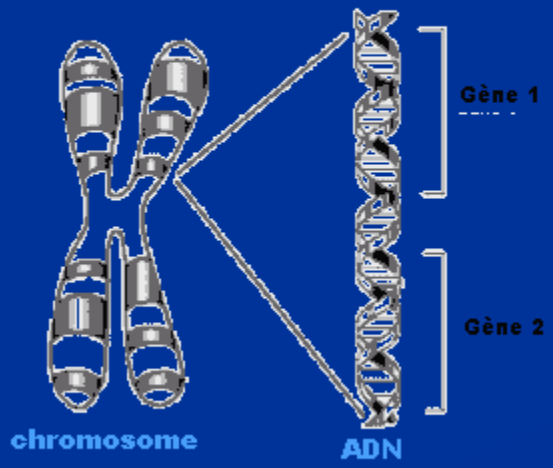
DNA

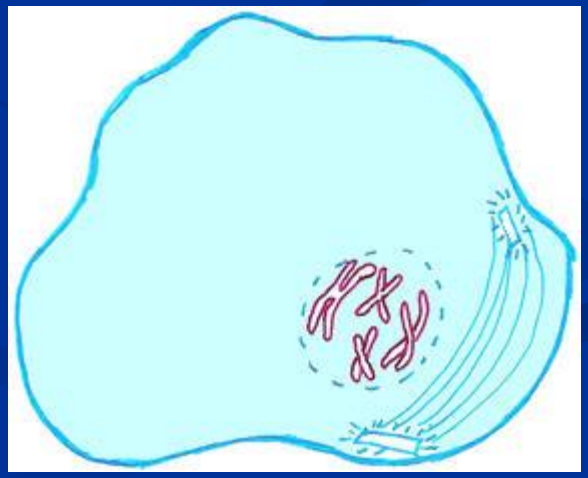
- Deoxyribonucleic acid
- It is our hereditary material (passed on from our parents)
- Found in the nucleus of our cells as chromatin

Chromatin vs. Chromosomes

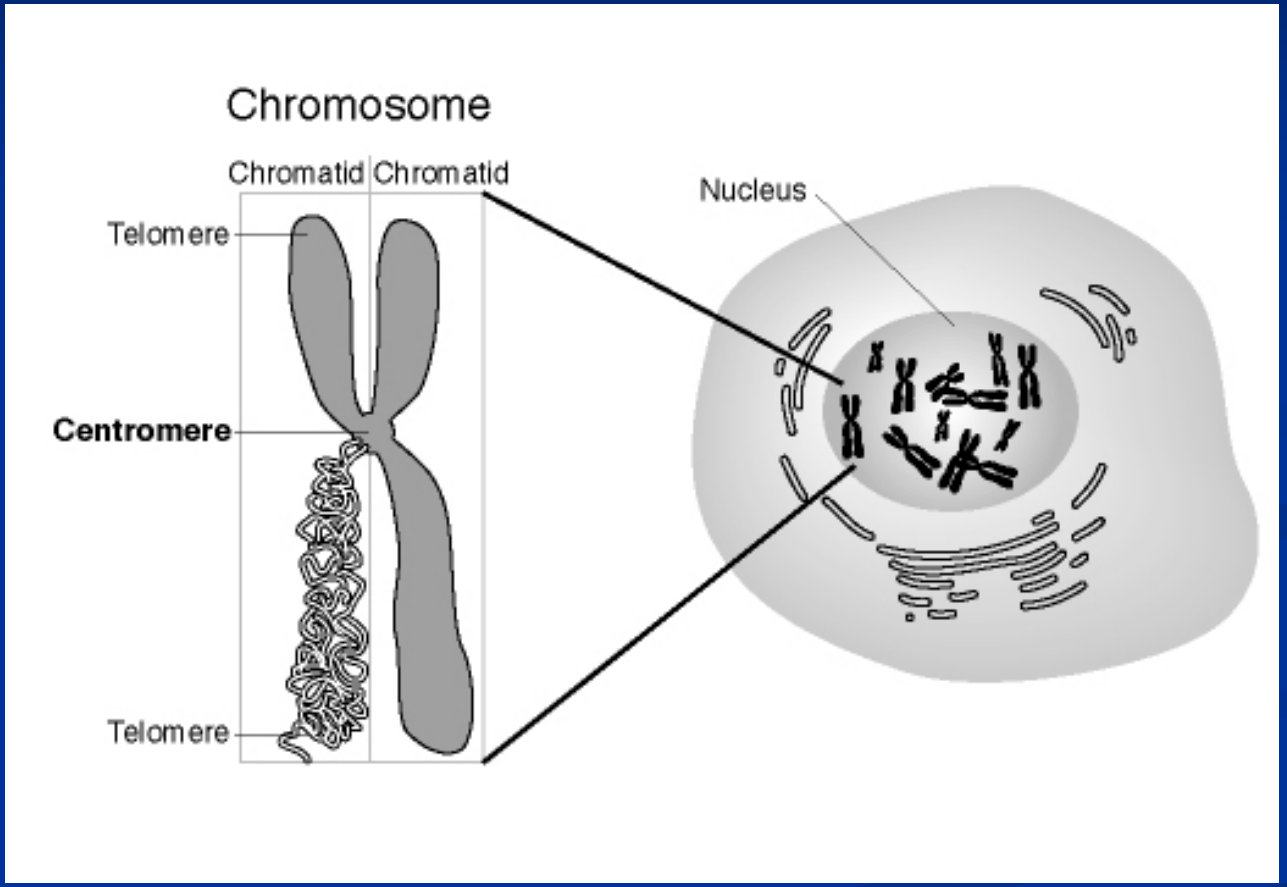
- Chromatin is uncoiled DNA
- Chromosomes are tightly coiled strands of DNA







Chromosomes



Human Karyotype

Chromosome #'s

- Humans-46
- Carrot-18
- Cat- 32
- Dog-78
- Earthworm-36
- Fruit fly-8
- Chimpanzee-48
- Adder's tongue fern-1,262

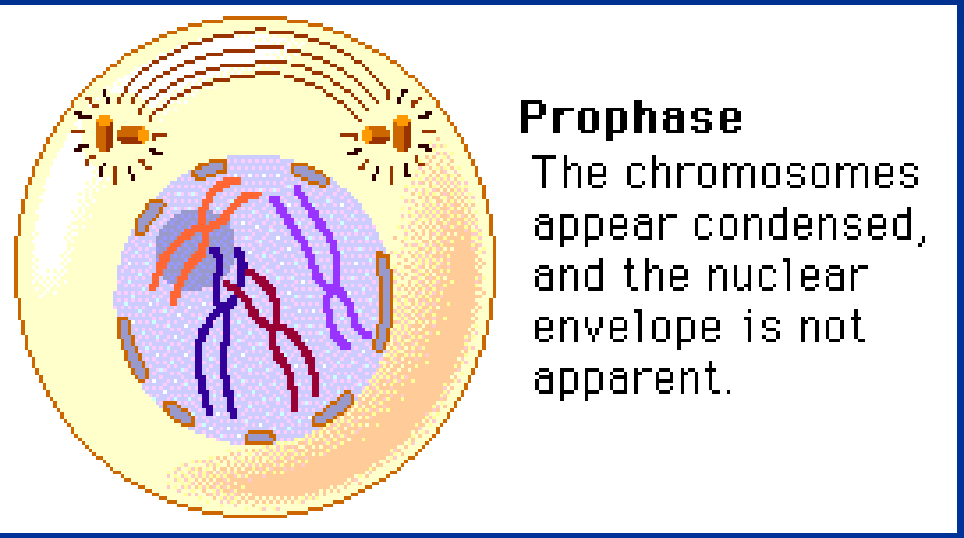
Mitosis

- Is the division of the nucleus
- Results in two new identical nuclei

Four Stages of Mitosis

- Prophase
- Metaphase
- Anaphase
- Telophase

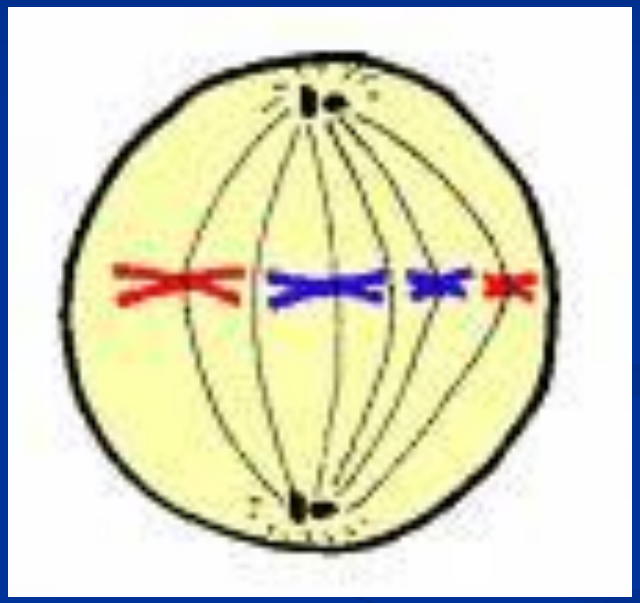
Prophase

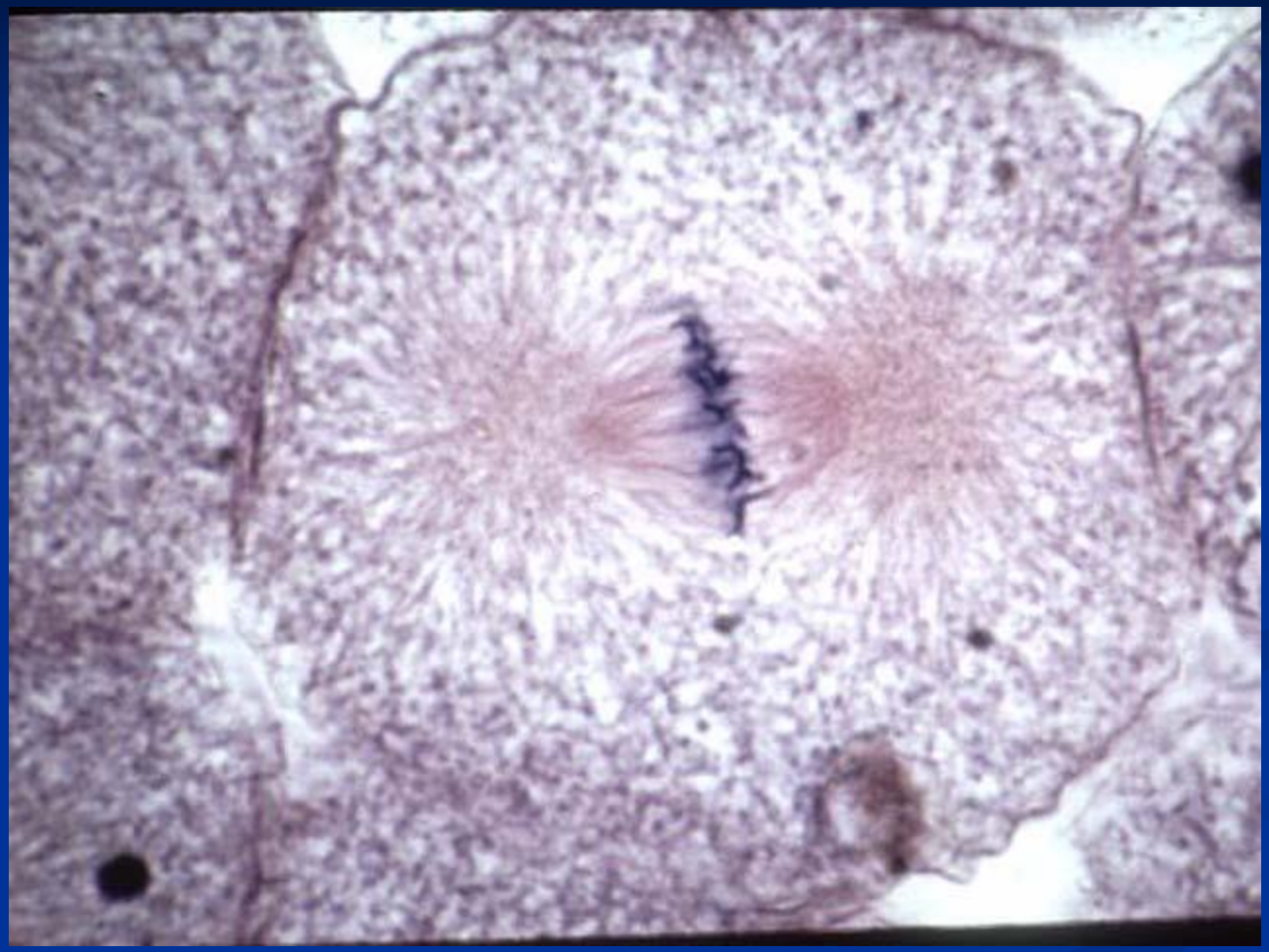


- Chromatin condenses to form chromosomes.
- Centrioles move to opposite ends of the cell
- Spindle fibers form bridge between the ends of the cell.
- Nuclear envelope breaks down.

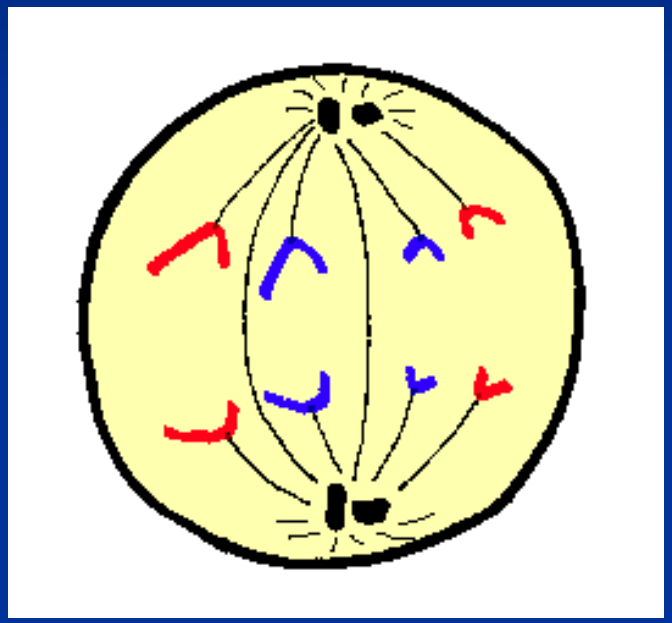
Metaphase

- Chromosomes line up in the center of the cell attaching to spindle fibers by a centromere.

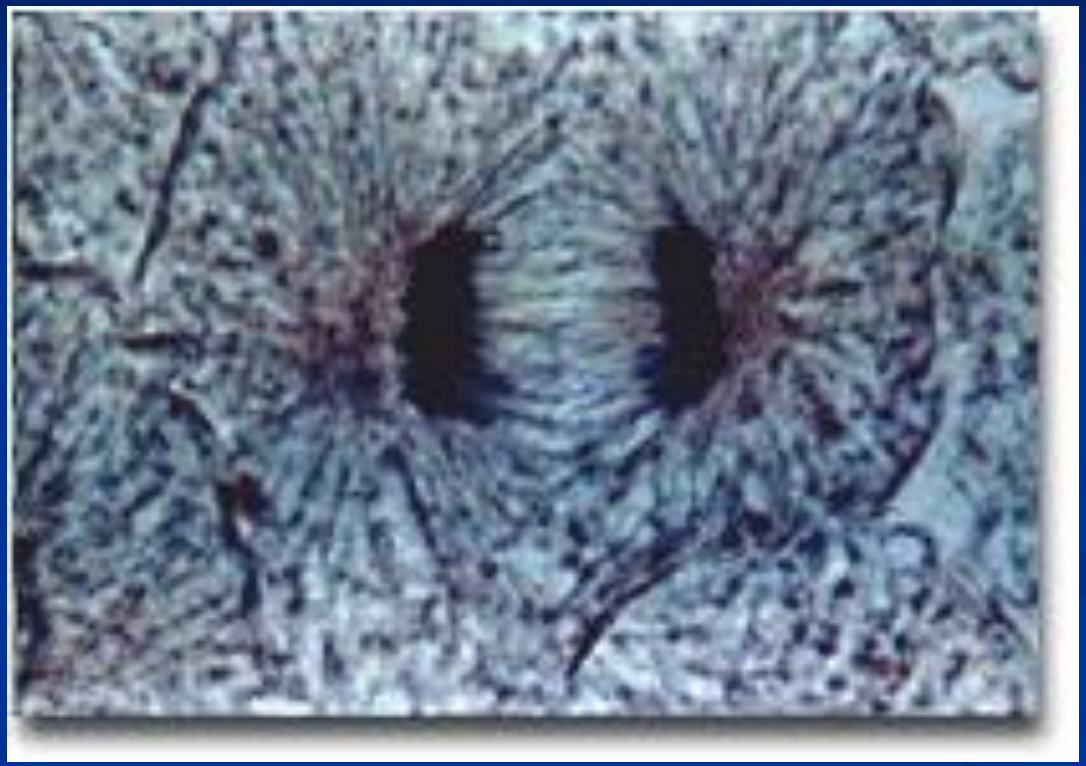




Anaphase

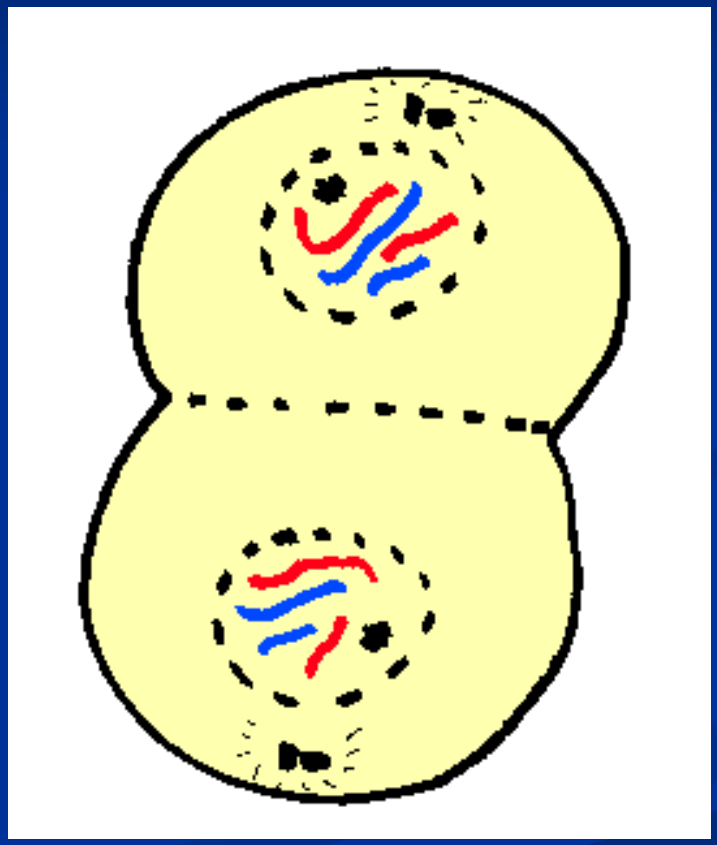


- Centromeres split
- Chromatids separate and become chromosomes.
- The new chromosomes move to opposite ends of the cell
- Cell begins to stretch out as the ends are pushed apart.



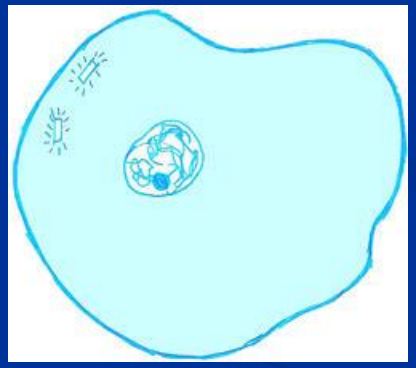
Telophase

- Chromosomes stretch out
- New nuclear envelope forms around each region of chromosomes



Cytokinesis

- The cell membrane pinches in around the middle of the cell.
- The cell splits in two
- Each daughter cell ends up with an identical set of chromosomes and half of the organelles.

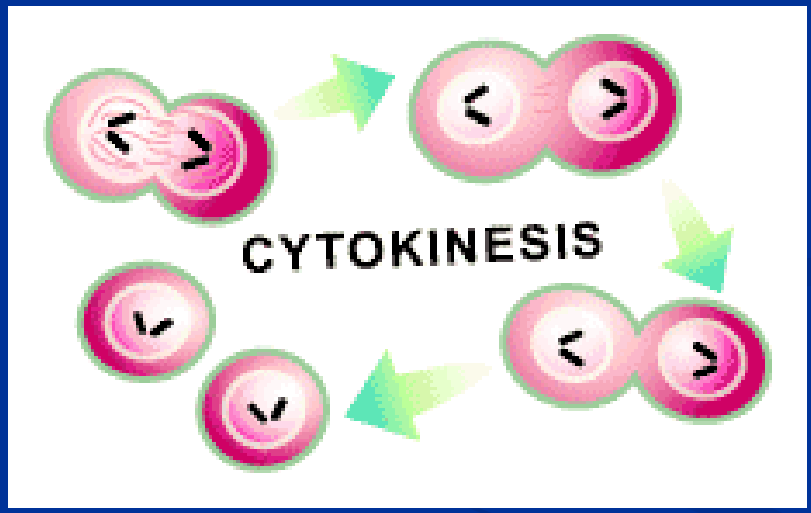


Cytokinesis

- The division of the cytoplasm
- Usually starts around the same time as telophase
- Results in two new identical cells (daughter cells) that have the same # of chromosomes as the original parent cell

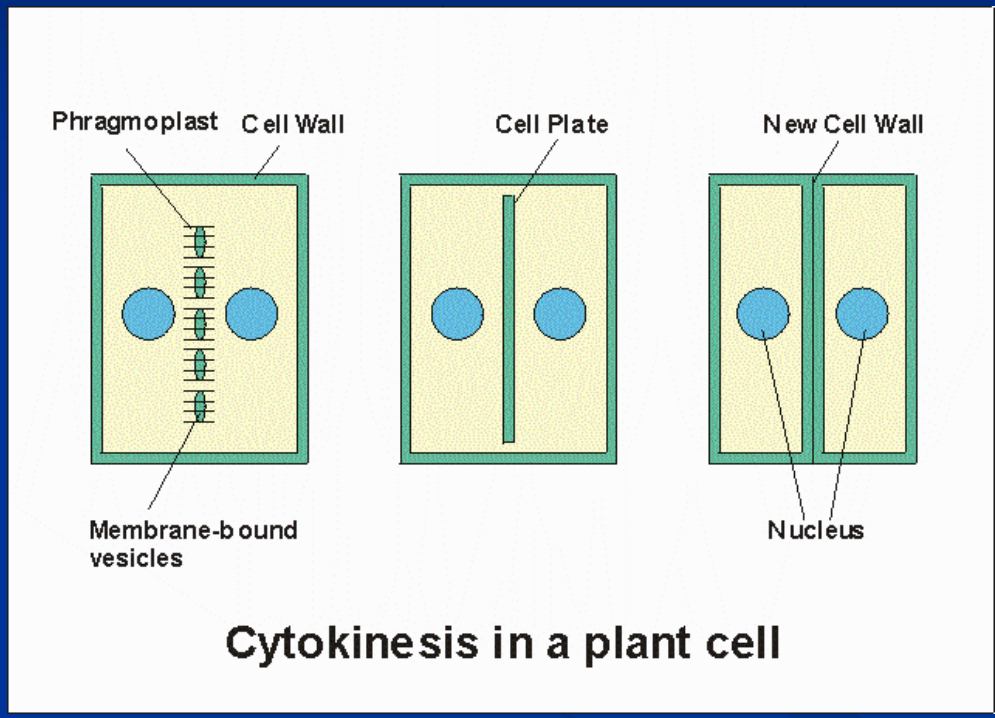
Cytokinesis in Animal Cells

- Cell membrane pinches together around the middle of the cell creating two new cells
- Each daughter cell gets about half of the organelles

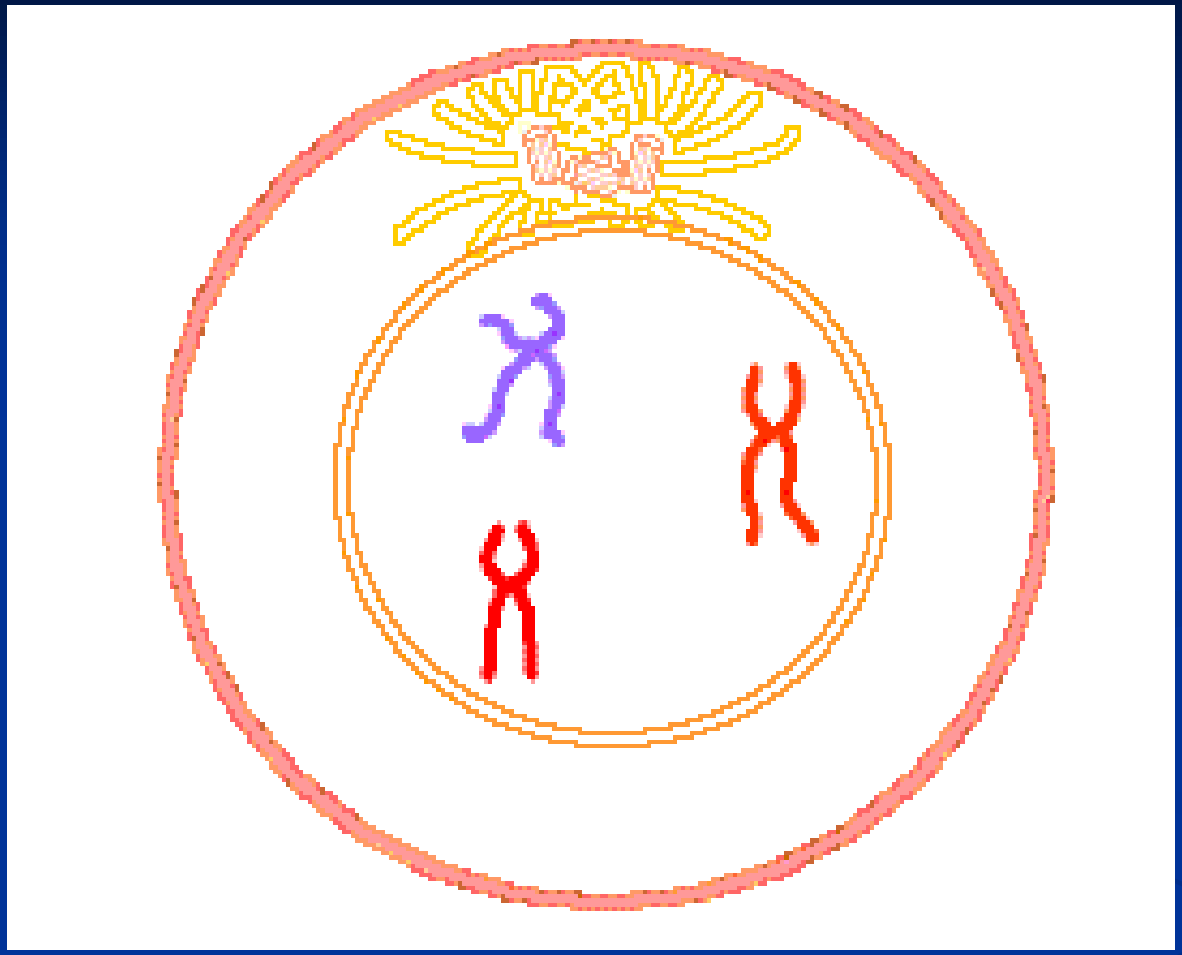


Cytokinesis in Plant cells

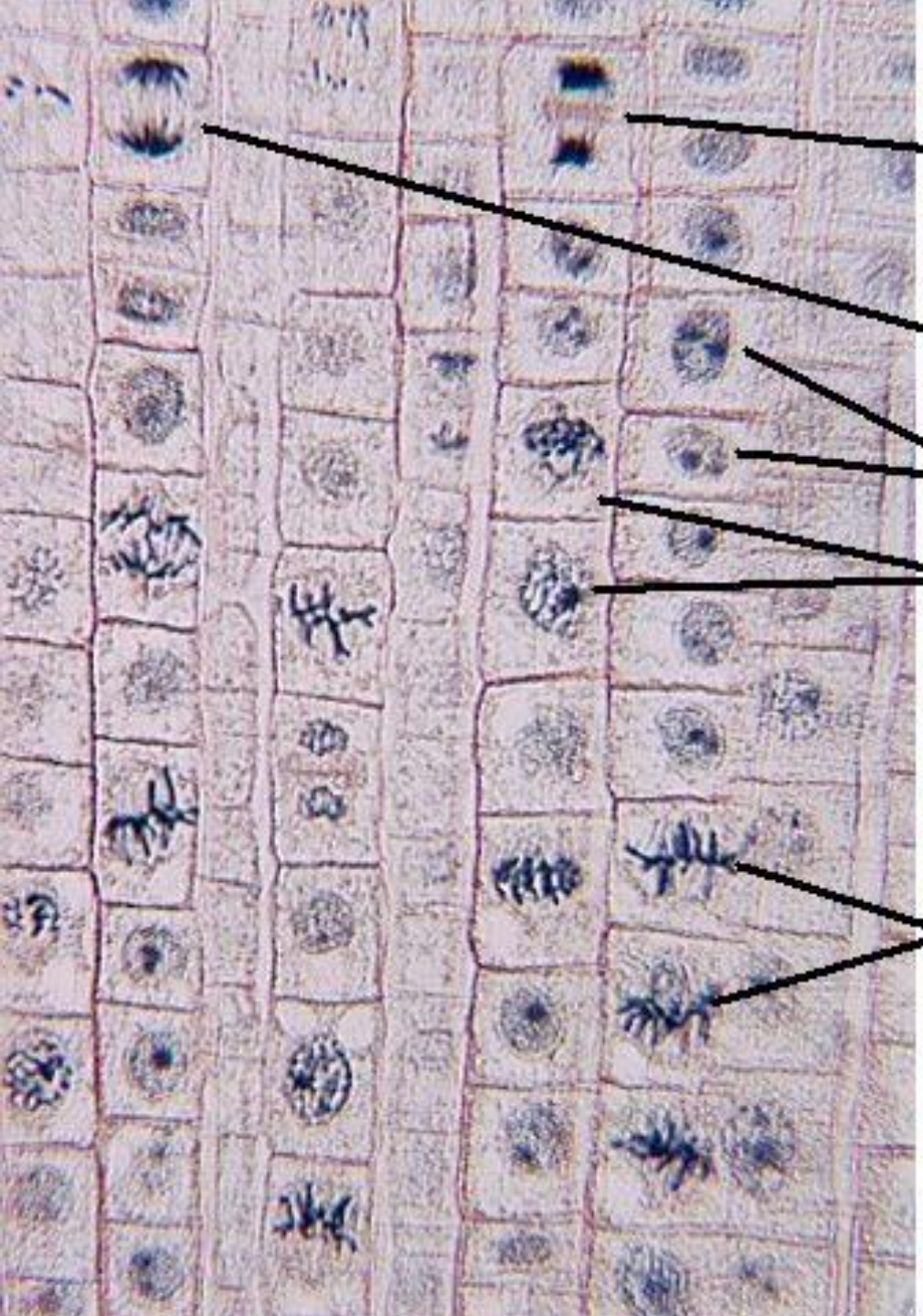
- Cell plate forms down the center of the cell
- The cell plate gradually develops into a cell membrane
- New cell walls form around the cell membrane



- http://www.youtube.com/watch?v=rgLJrvoX_qo&feature=related



Mitosis in root tip



Introduction to Parasitology

OBJECTIVES

By the end of this lecture the student should be able to:

1. **Define common terms describing host-parasite relationship.**
2. **Outline the broad classification of parasites.**
3. **Name examples of protozoan parasites.**
4. **Describe the life-cycle of *Giadia lamblia* as an example of intestinal protozoa.**
5. **Describe the main stages of the life-cycle of *Plasmodium* as an example of blood and tissue protozoa.**

DEFINITIONS

Infection:

The entry , development and multiplication of an infectious agent in the body of humans or animals.

The result may be:

inapparent (asymptomatic) infection, or
manifest (symptomatic) infection..

Host:

A person or other living animal which harbours an infectious agent under natural conditions .

Definitive host:

(primary host) a host in which the parasite passes its sexual stage.

Intermediate host:

(secondary host) a host in which the parasite passes its larval or asexual stages.

carrier:

A person or animal that harbours a specific infectious agent in the absence of clinical disease and serves as a potential source of infection

pathogenesis:

Production and development of disease.

pathogenicity:

Capability of an infectious agent to cause disease in a susceptible host.

Parasitism:

A relationship in which an organism (the parasite) benefits from the association with another organism (the host) whereas the host is harmed in some way.

commensalism:

Kind of relationship in which one organism , the commensal , is benefited whereas the other organism , the host , is neither harmed or helped by the association.

ectoparasite: parasite that lives on the outer surface of its host.

endoparasite: Parasite that lives inside its host.

zoonosis: Disease of animals that is transmissible to humans .

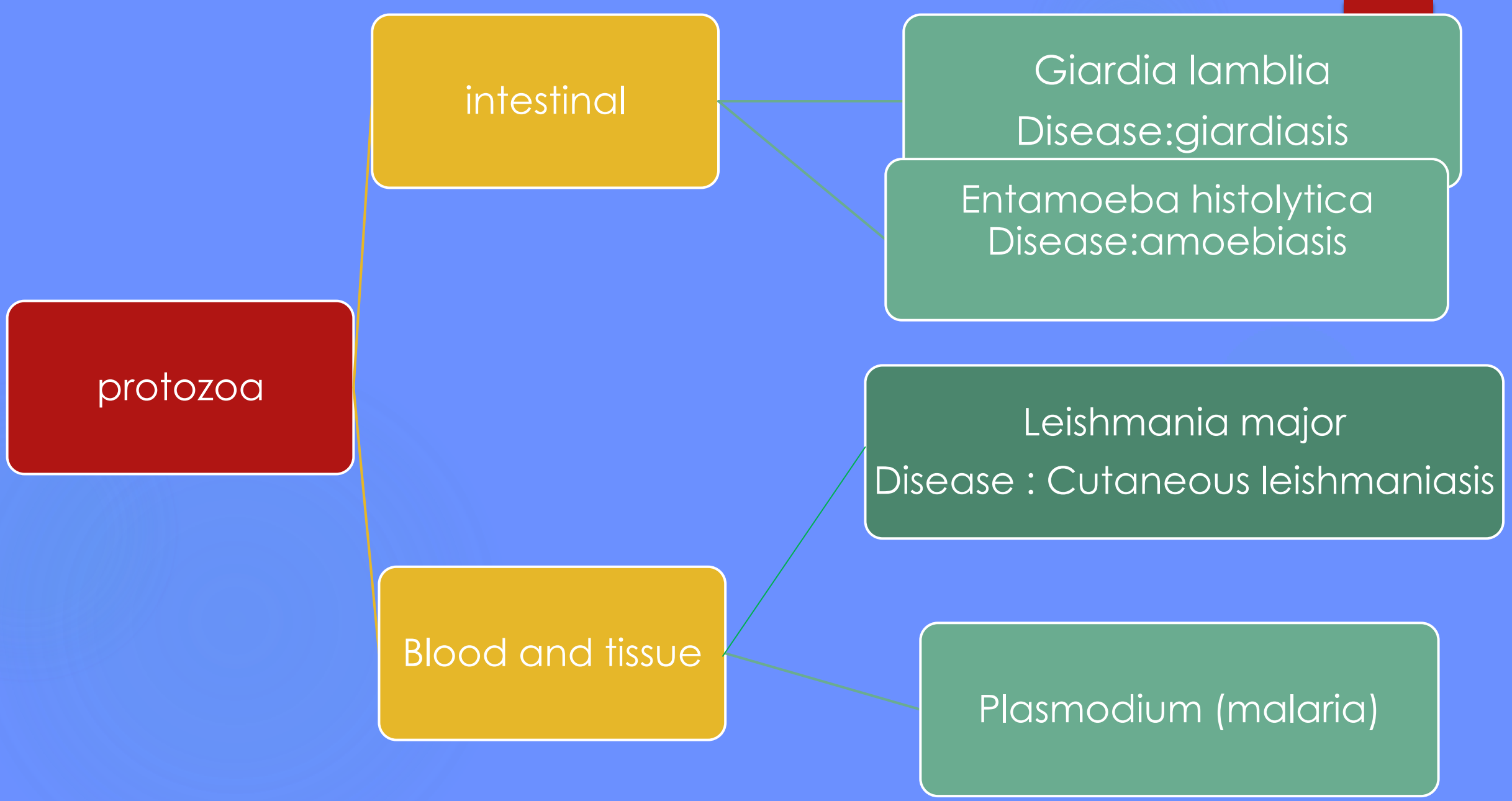
CLASSIFICATION OF PARASITES

PROTOZOA	HELMINTHS
Unicellular Single cell for all functions	Multicellular Specialized cells
1:Amoebae: move by pseudopodia. 2:Flagellates: move by flagella. 3:Ciliates: move by cilia 4:Apicomplexa(Sporozoa) tissue parasites	<u>Round worms (Nematodes):</u> - elongated, cylindrical, unsegmented. <u>Flat worms :</u> - Trematodes: leaf-like, unsegmented. - Cestodes: tape-like, segmented.

Note that protozoa is named according to the movement, helminthes is according to shape

Scientific names of parasites follow Zoological Classification

Scientific names of parasites follow Zoological Classification ending in Genus and Species.

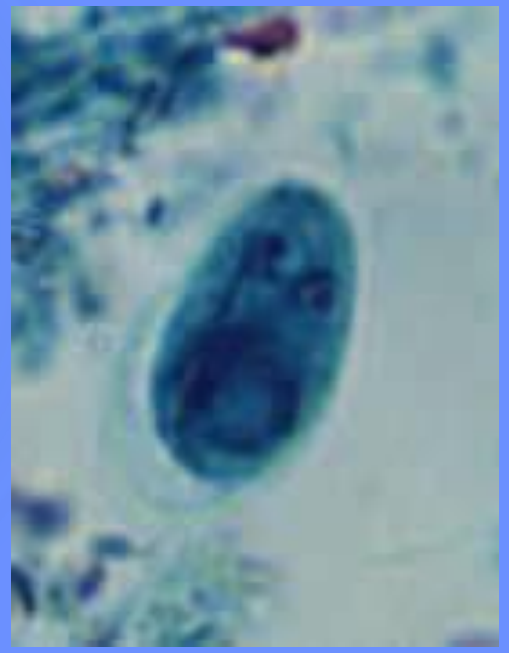

protozoa
intestinal
Blood and tissue
Giardia lamblia
Disease:giardiasis
Entamoeba histolytica
Disease:amoebiasis
Leishmania major
Disease : Cutaneous leishmaniasis
Plasmodium (malaria)

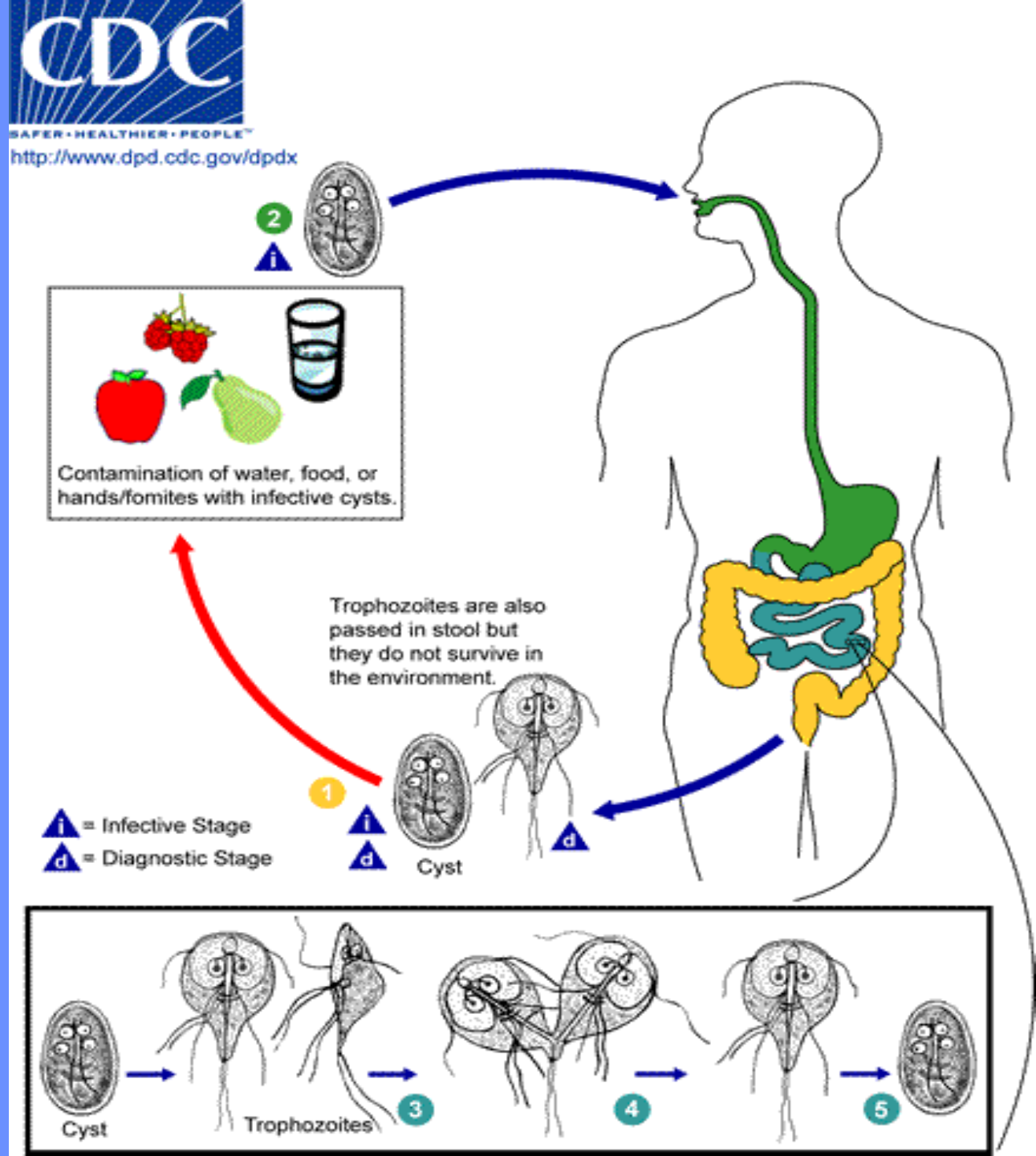
Example of intestinal protozoa:

On the right we have giardia lamblia(intestinal protozoa) life cycle .
It first enters the body in the form of ***Giardia*** **cyst** (lower right) to survive the stomachs acidity.
When it reaches the intestine it starts the infictive stage in the form of ***Giardia*** **trophozoite.** When leaving only the cyst form can survive the outside environment.

Giardia **trophozoite**

Giardia **cyst**



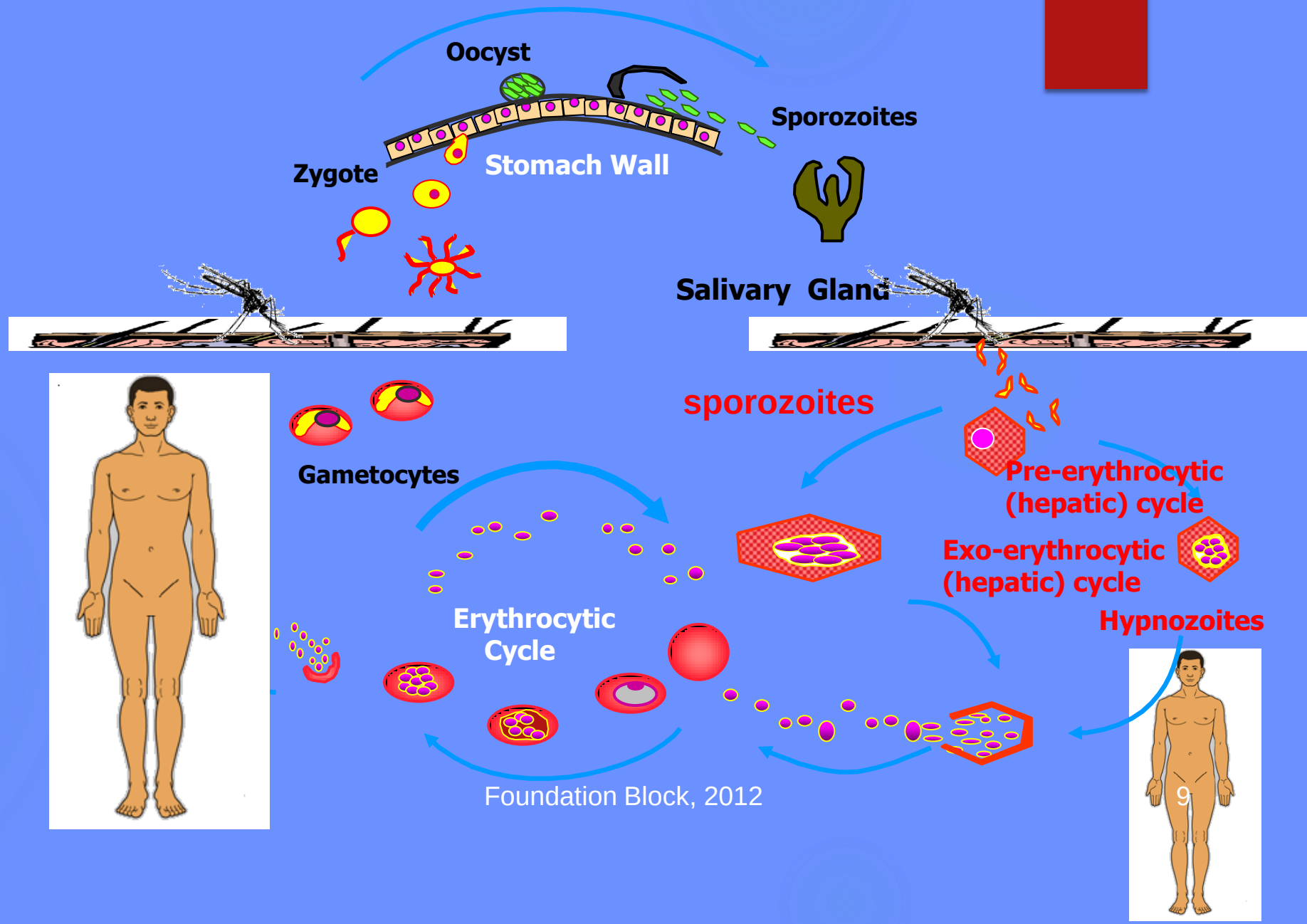


LIFE CYCLE OF MALARIA

Example of blood and tissue protozoa

Four species of malaria :

Plasmodium falciparum
Plasmodium vivax
Plasmodium ovale
Plasmodium malariae



MCQs

1-a host in which the parasite passes it sexual stages is:

a-intermediate host b- Carrier

C-definitive host d- Secondary host

2- The type of relationship which the host isn't harmed or helped by the association:

a- commensalism b- Parasitism

c- Pathogenicity d-infection

3- The parasite that lives on the outer surface of the host is called endoparasite:

a-true b-false

4- The giardiasis disease is caused by:

a- giardia histolytica b-helminths

c-plasmodium species d-giardia lamblia

5-Giardia form inside the body is giardia trophozite:

a-true

b-false

6-The pathogenesis of malaria is mainly due to invasion of:

a-white blood cells

b-red blood cells

c-platelets

d-lymph nodes

Answers:

1-C 2-A 3-B 4-D 5-A 6-B

Thank you

Mutations

What Are Mutations?

- Changes in the nucleotide sequence of DNA
- May occur in somatic cells (aren't passed to offspring)
- May occur in gametes (eggs & sperm) and be passed to offspring

Are Mutations Helpful or Harmful?

- Mutations happen regularly
- Almost all mutations are neutral
- Chemicals & UV radiation cause mutations
- Many mutations are repaired by enzymes

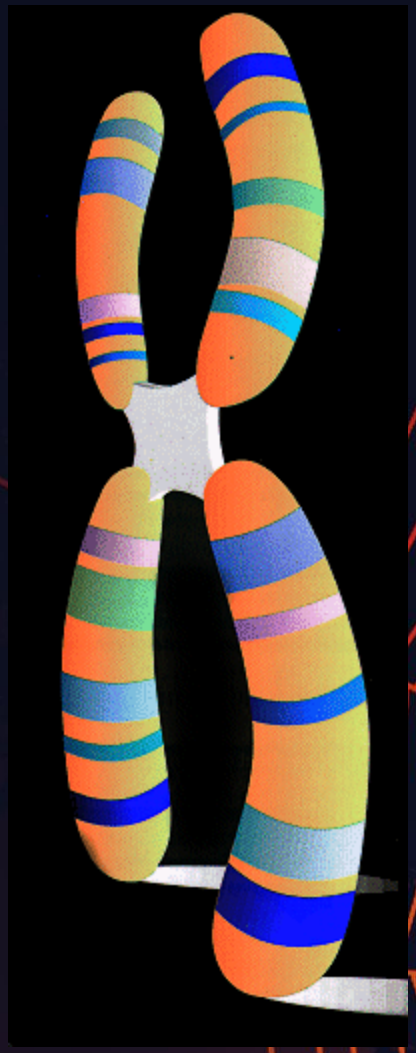
Are Mutations Helpful or Harmful?

- Some type of skin cancers and leukemia result from somatic mutations
- Some mutations may improve an organism's survival (beneficial)

Types of Mutations

Chromosome Mutations

- May Involve:
  - **Changing the structure** of a chromosome
  - The **loss or gain** of part of a chromosome

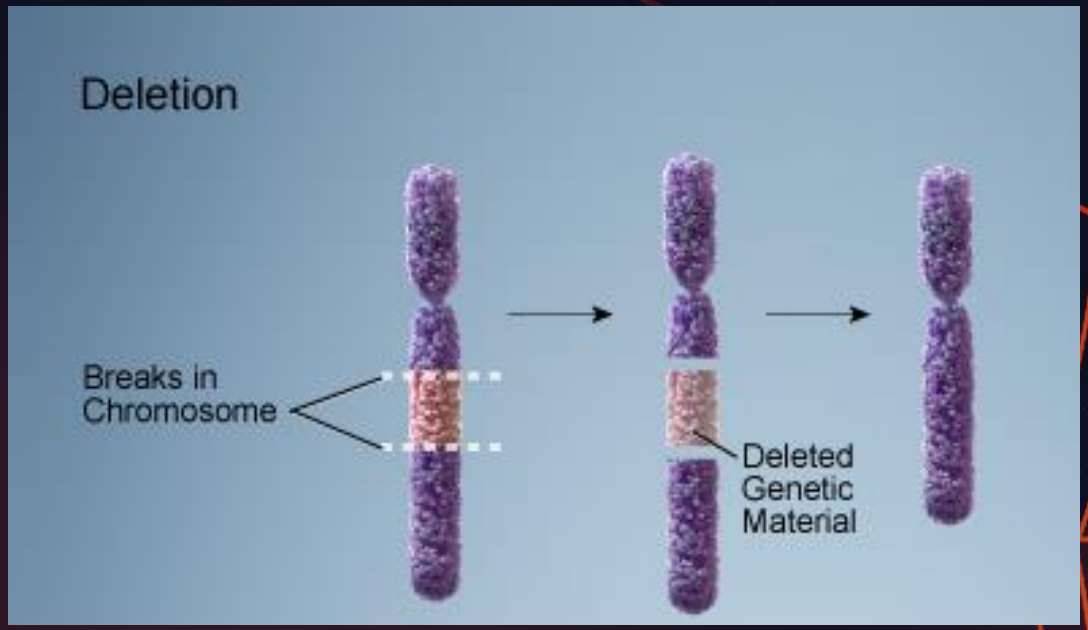


Chromosome Mutations

- Five types exist:
  - Deletion
  - Inversion
  - Translocation
  - Nondisjunction
  - Duplication

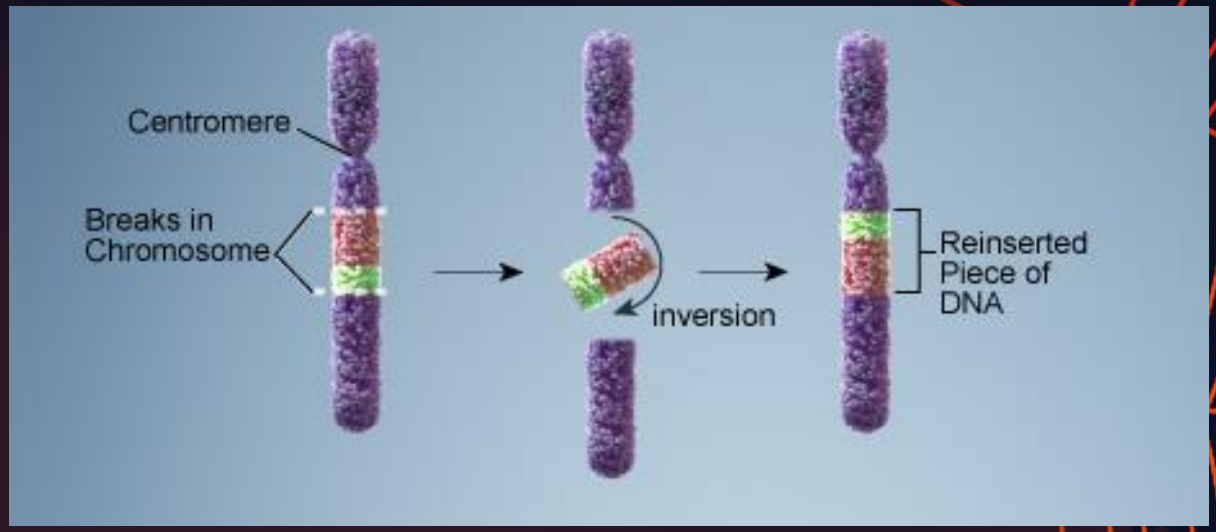
Deletion

- Due to **breakage**
- A **piece** of a chromosome is **lost**



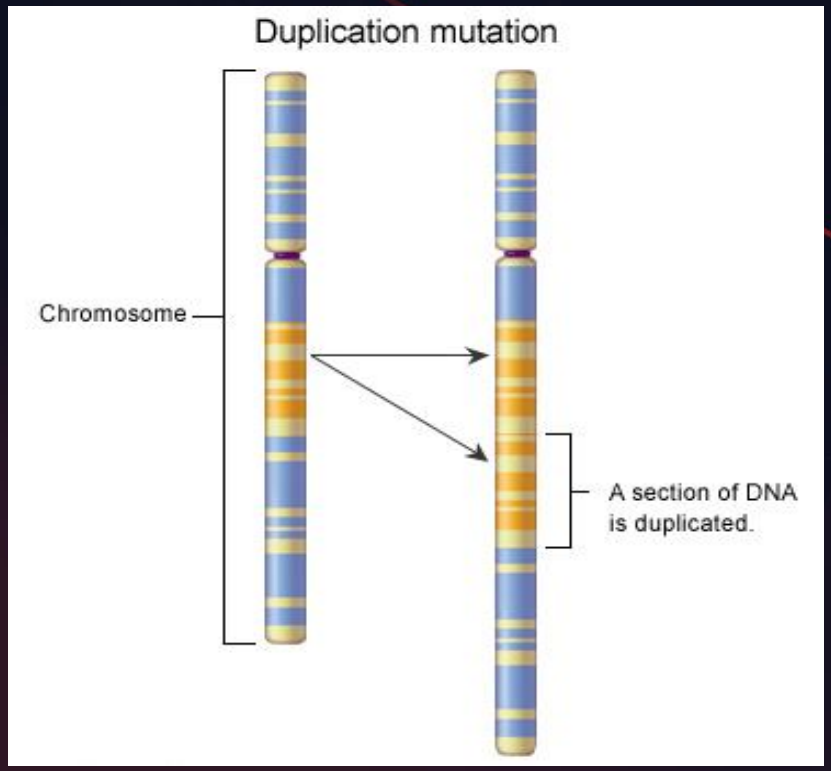
Inversion

- Chromosome segment **breaks off**
- Segment flips around **backwards**
- Segment **reattaches**



Duplication

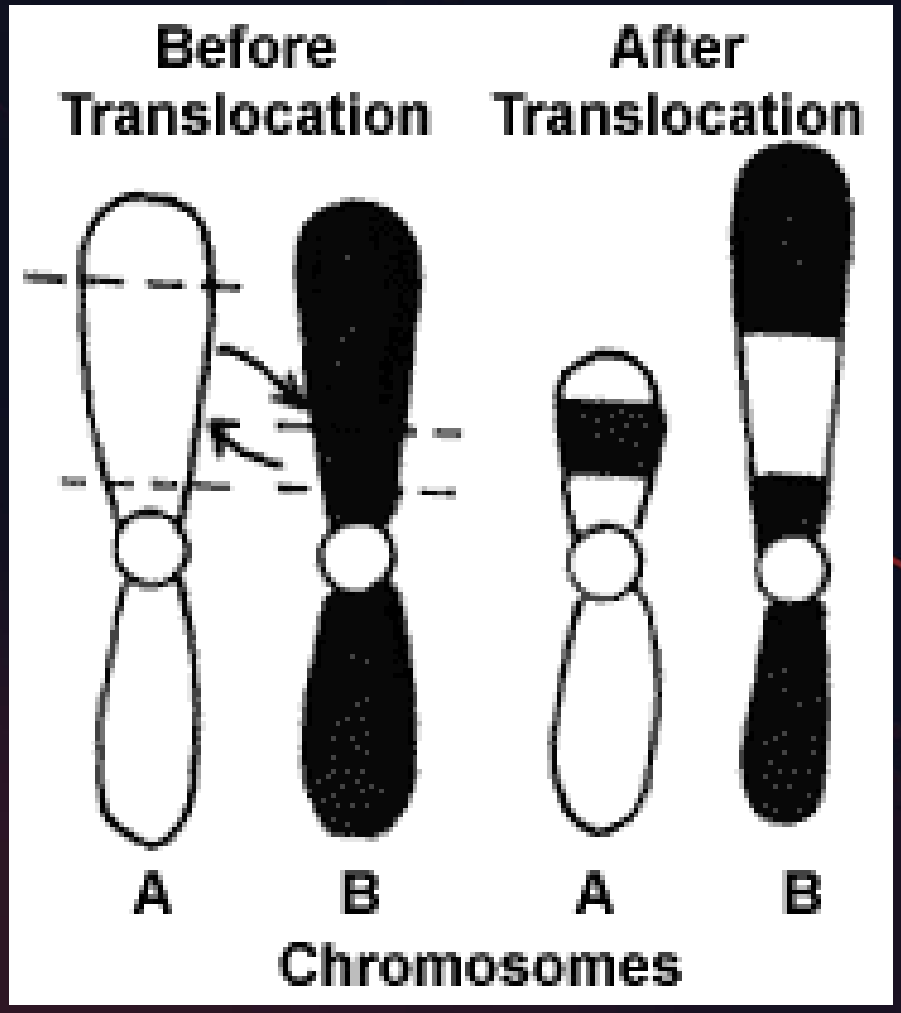
- Occurs when a gene **sequence is repeated**



Translocation

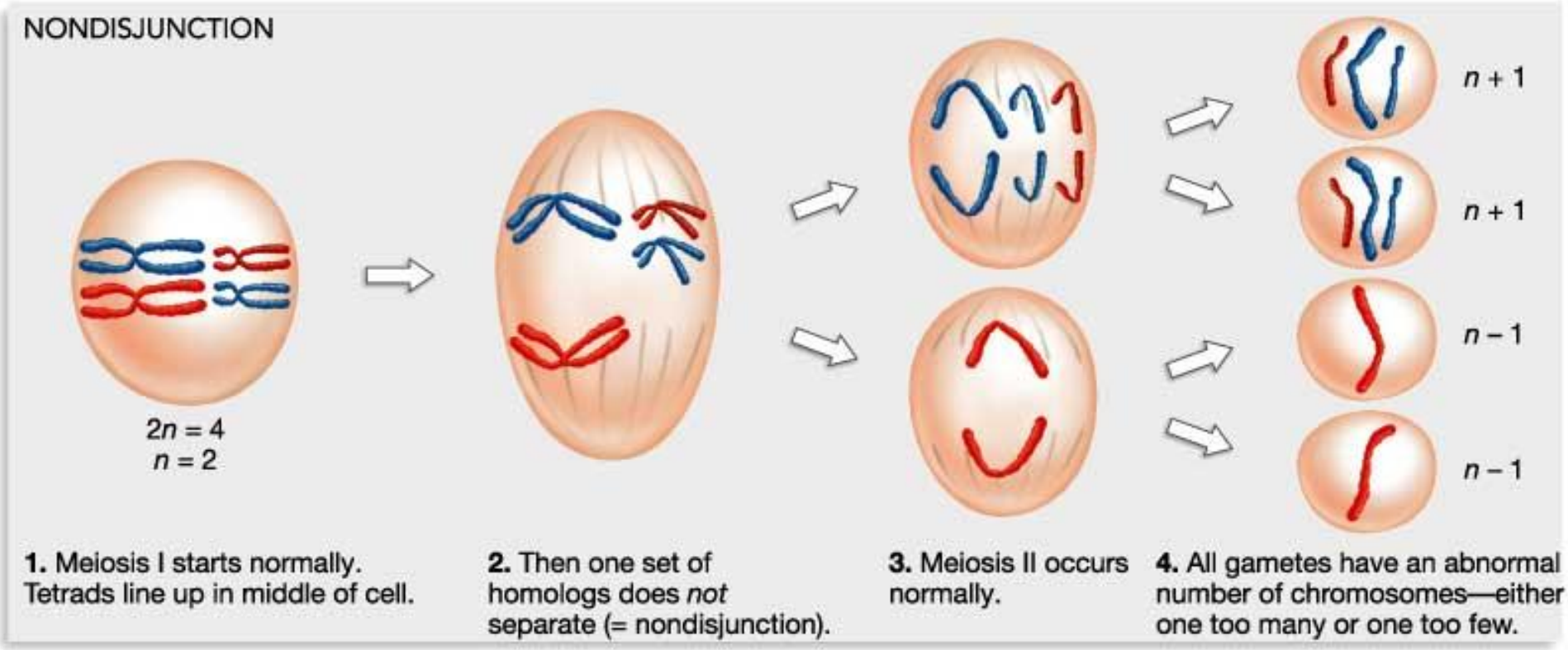
- Involves **two chromosomes** that aren't homologous
- **Part** of one chromosome is **transferred to another** chromosomes

Translocation

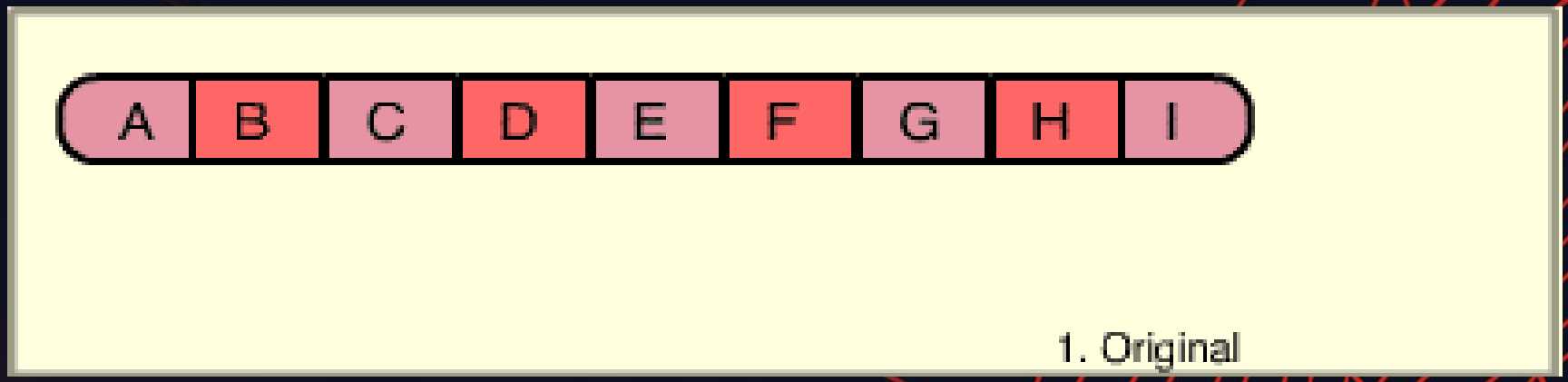


Nondisjunction

- **Failure** of chromosomes **to separate** during meiosis
- Causes gamete to have **too many** or **too few** chromosomes


NONDISJUNCTION
2n = 4
n = 2
n + 1
n + 1
n – 1
n – 1
1. Meiosis I starts normally. Tetrads line up in middle of cell.
2. Then one set of homologs does not separate (= nondisjunction).
3. Meiosis II occurs normally.
4. All gametes have an abnormal number of chromosomes—either one too many or one too few.

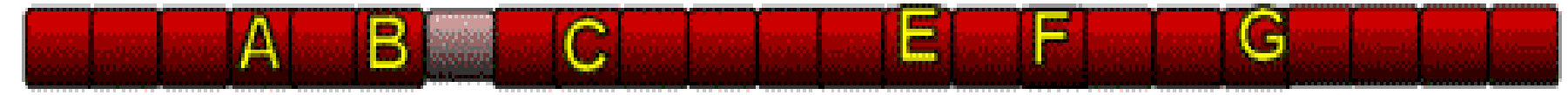
Chromosome Mutation Animation



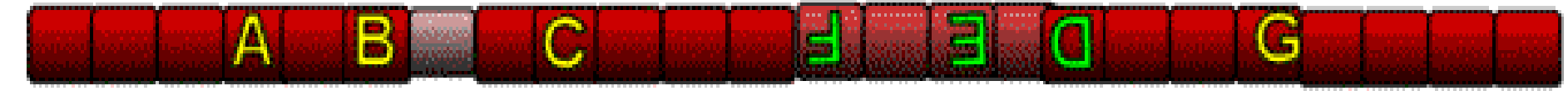
Original Chromosome

Duplication

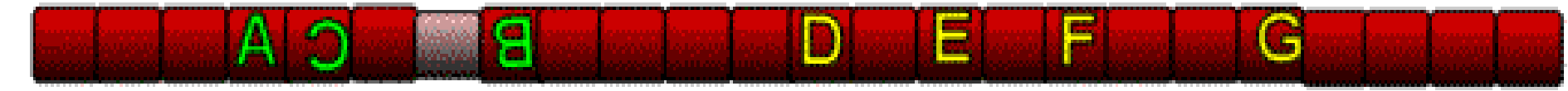
Deletion



Inversion



Inversion



Gene Mutations

- Change in the **nucleotide sequence** of a gene
- May only involve a single nucleotide
- May be due to **copying errors**, **chemicals**, **viruses**, etc.

Types of Gene Mutations

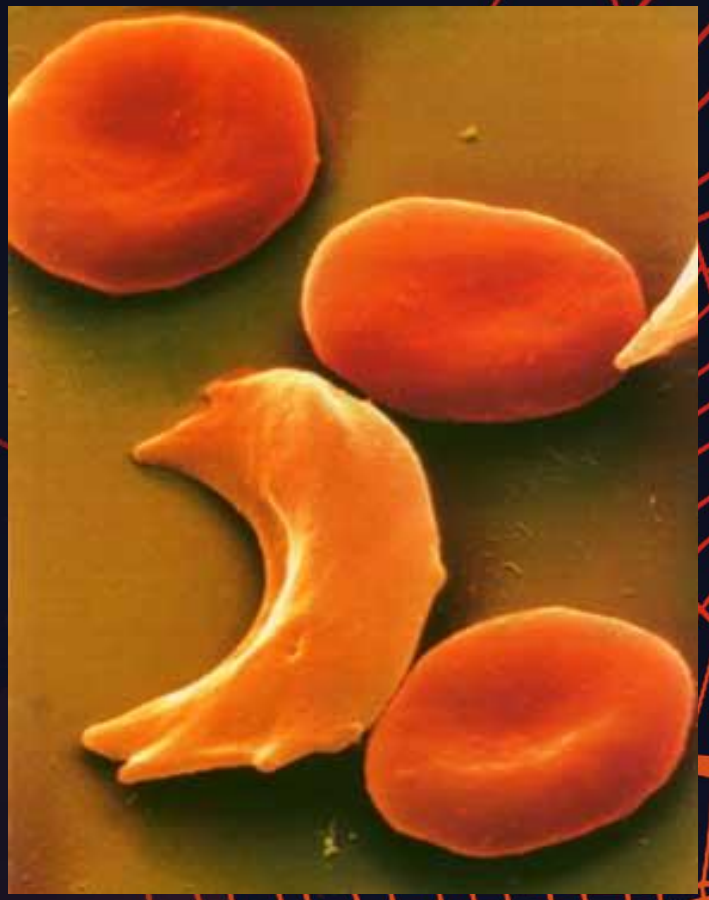
- Include:
  - Point Mutations
  - Substitutions
  - Insertions
  - Deletions
  - Frameshift

Point Mutation

- Change of a **single** nucleotide
- Includes the deletion, insertion, or substitution of **ONE** nucleotide in a gene

Point Mutation

- **Sickle Cell disease** is the result of one nucleotide substitution
- Occurs in the **hemoglobin gene**



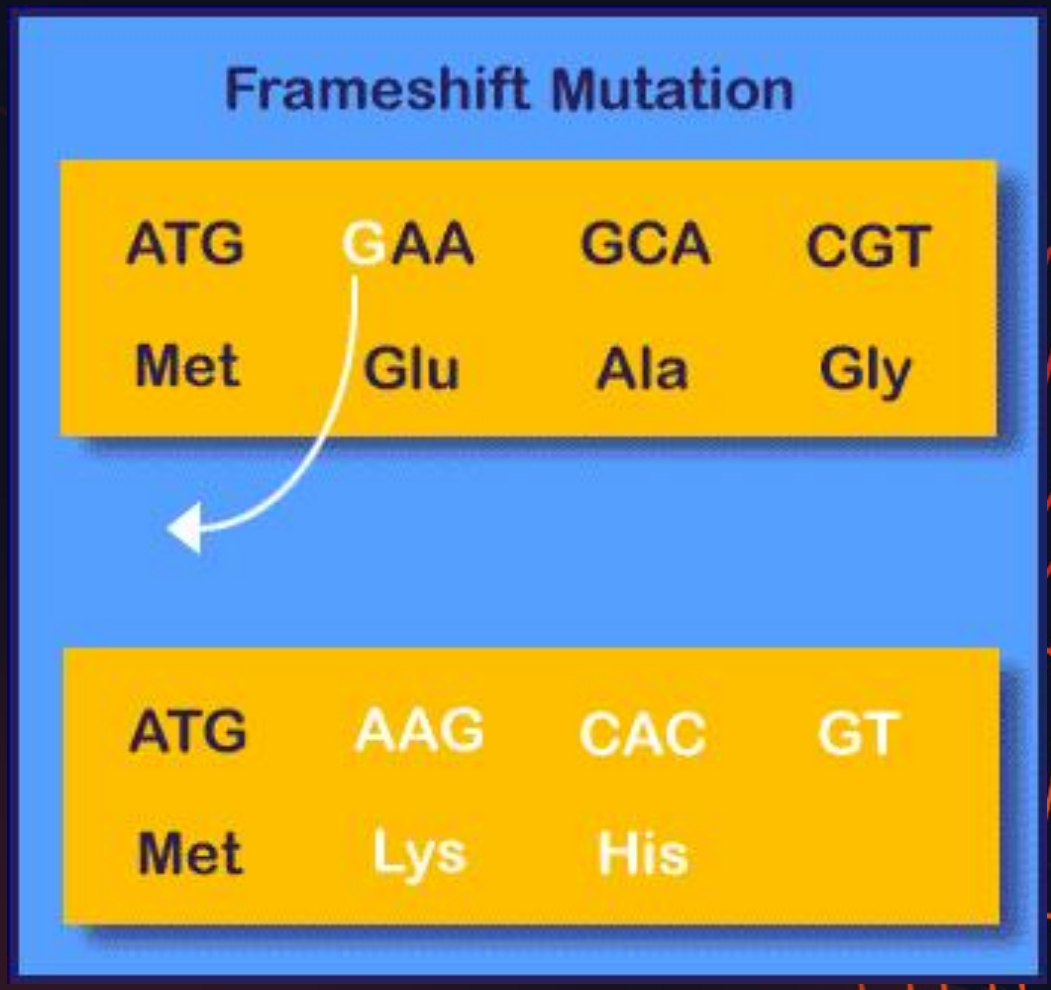
Frameshift Mutation

- **Inserting or deleting** one or more nucleotides
- Changes the "**reading frame**" like changing a sentence
- **Proteins** built **incorrectly**

Frameshift Mutation

- Original:
  - The fat cat ate the wee rat.
- Frame Shift (“a” added):
  - **The fat c**a**a tet hew eer at.**

Amino Acid Sequence Changed



Gene Mutation Animation