

GRADE 12TH BIOLOGY
GENETICS
PART 3

Prepared by Tame.Y

Cont.....

Dihybrid inheritance

What patterns do we get if we consider the inheritance of two genes at the same time? This is known as **dihybrid inheritance**

dihybrid inheritance is the inheritance of two pair of contrasted characteristics (two gene) considered at the same time or the inheritance of two characteristics at the same time

Example-take plant height and seed shape

p1: tall plant with round seed x short plant with wrinkled colour.

Are alleles always simply dominant or recessive?

- ❖ The short answer to this is no. Sometimes alleles are
 - Complete dominant alleles
 - Incomplete dominant alleles
 - Codominant

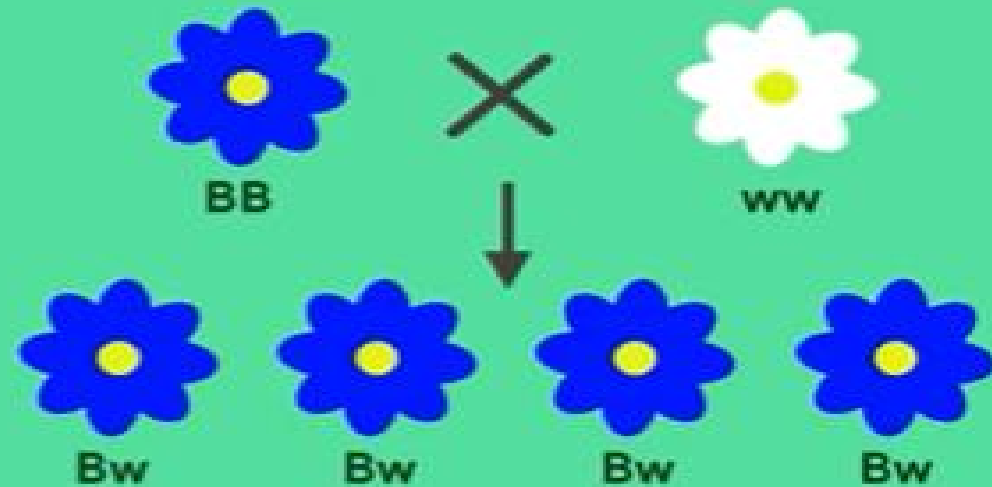
Cont.....

Complete Dominance

Dominant allele will mask the effect of the recessive allele completely

B : Blue coloured flowers
w : white coloured flowers

BB : Plant with Blue flowers
ww : Plant with white flowers



Cont.....

Incomplete Dominance

Dominant allele masks the effect of the recessive one, but not completely

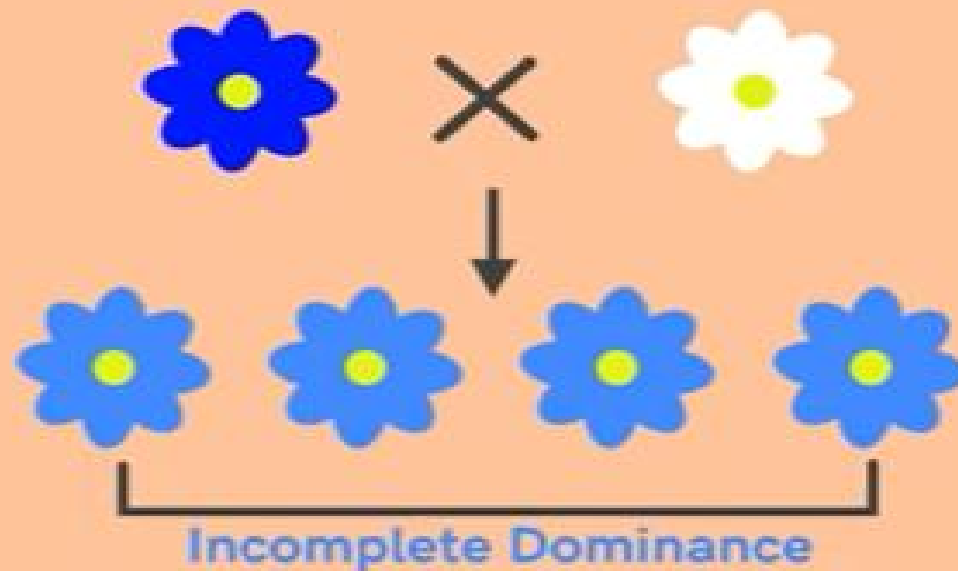
Phenotype : All light blue
(Intermediate)

B : Blue coloured flowers

W : white coloured flowers

BB : Plant with Blue flowers

WW : Plant with white flowers



Cont.....

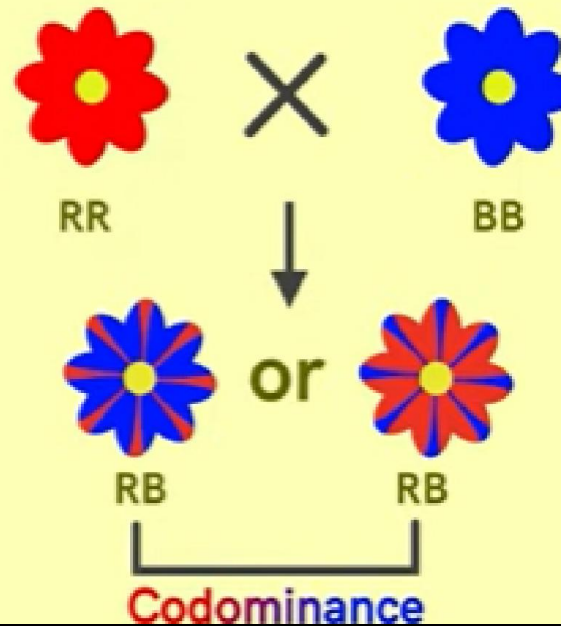
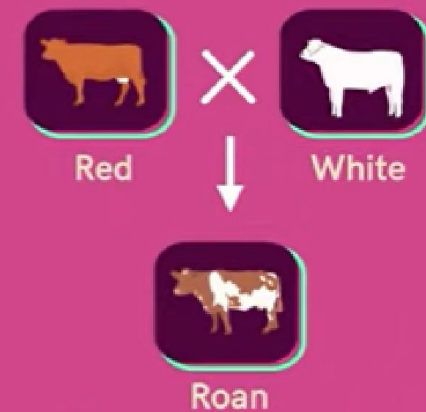
Codominance

Both the alleles
are dominant

Phenotype : Red with Blue patches
Blue with Red patches

Genotype : All "RB"

RR : Plant with Red flowers } Both traits
BB : Plant with Blue flowers } Dominant



What is the physical basis for these patterns of inheritance?

- ❖ Gene is a part of a chromosome.
- ❖ To understand the patterns of inheritance we have, we must look at how chromosomes behave when gametes are formed.
- ❖ For gametes to be formed, special cells in the sex organs of the organism divide by a process known as **meiosis**.

Cont.....

When a cell divides in this manner, there are three key outcomes:

- ❖ It produces four 'daughter' cells
- ❖ These daughter cells have only half the number of chromosomes of the original cell; they have one chromosome from each **homologous** pair
- ❖ The daughter cells show genetic variation

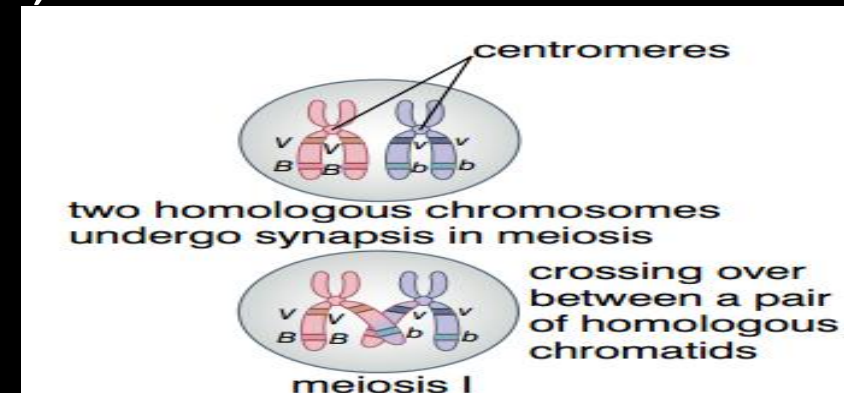
Cont....

- ❖ First, if you think carefully, a cell does not normally divide to produce four cells – it produces two.
- ❖ Therefore, meiosis must entail two divisions. We call these **meiosis I** and **meiosis II**.

Cont.....

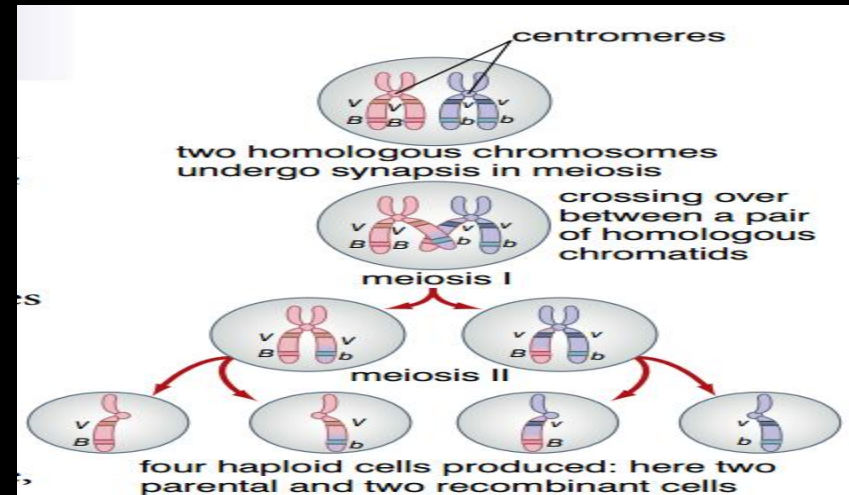
Before any division takes place

- ❖ at the start of the process, each chromosome is a double structure; it is made of two chromatids held together by a centromere
- ❖ Before any division takes place, chromatids from different chromosomes in the homologous pair undergo 'crossing over'. In this process, they exchange sections of DNA
- ❖ Notice that, because of crossing over, none of these chromatids are the same

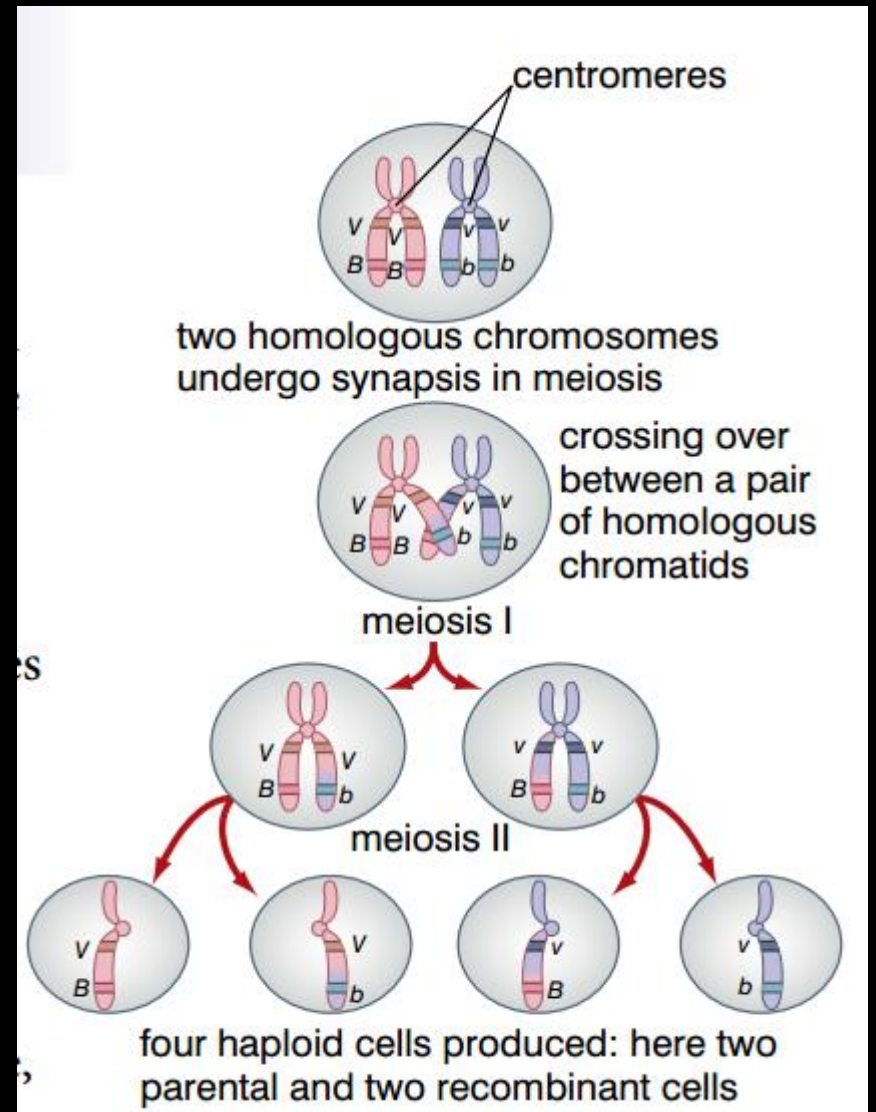


Cont...

- ❖ After this has taken place, meiosis I follows and the two chromosomes that make up the pair are separated into different cells.
- ❖ In meiosis II, the two chromatids that make up each chromosome are separated into separate cells.
- ❖ Notice that, because of crossing over, none of these chromatids are the same.



❖ There is genetic variation in the daughter cells which also have only half the original chromosome number (**haploid**) number of chromosomes, unlike the parent cell which had the **diploid** number of chromosomes.



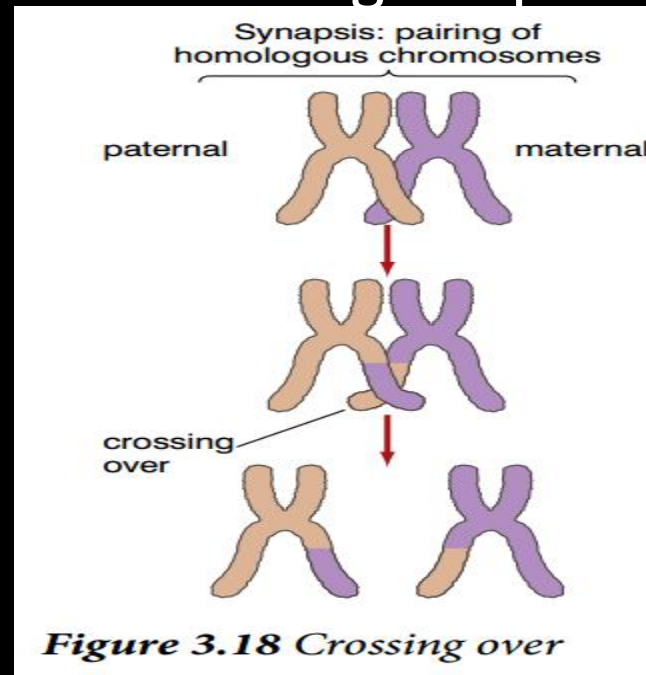
Cont....

During meiosis, the following things happen to the chromosomes:

- ❖ They duplicate
- ❖ They 'condense
- ❖ The chromosomes of a homologous pair (each one by now duplicated) 'find' each other (this is called **synapsis** and no one is quite sure how it happens) and form a **bivalent**.

Cont.....

- ❖ chromatids from different chromosomes undergo crossing over. These chromatids are called non-sister chromatids; the chromatids that make up one chromosome are sister chromatids
- ❖ all four chromatids in the homologous pair are genetically different



Cont.....

- ❖ The chromosomes (or chromatids) are moved around the cell by fibers that make up a spindle. This is achieved by the spindle fibers contracting and pulling the chromosomes/chromatids.
- ❖ In the two divisions of meiosis, the chromosomes attach to the spindles differently so that:
 - ✓ in meiosis I, whole chromosomes are moved and the chromosomes that make up a homologous pair are separated
 - ✓ in meiosis II, the chromatids that make up each chromosome are separated.

Cont....

The main stages of meiosis I

❖ It is divided into four phases:

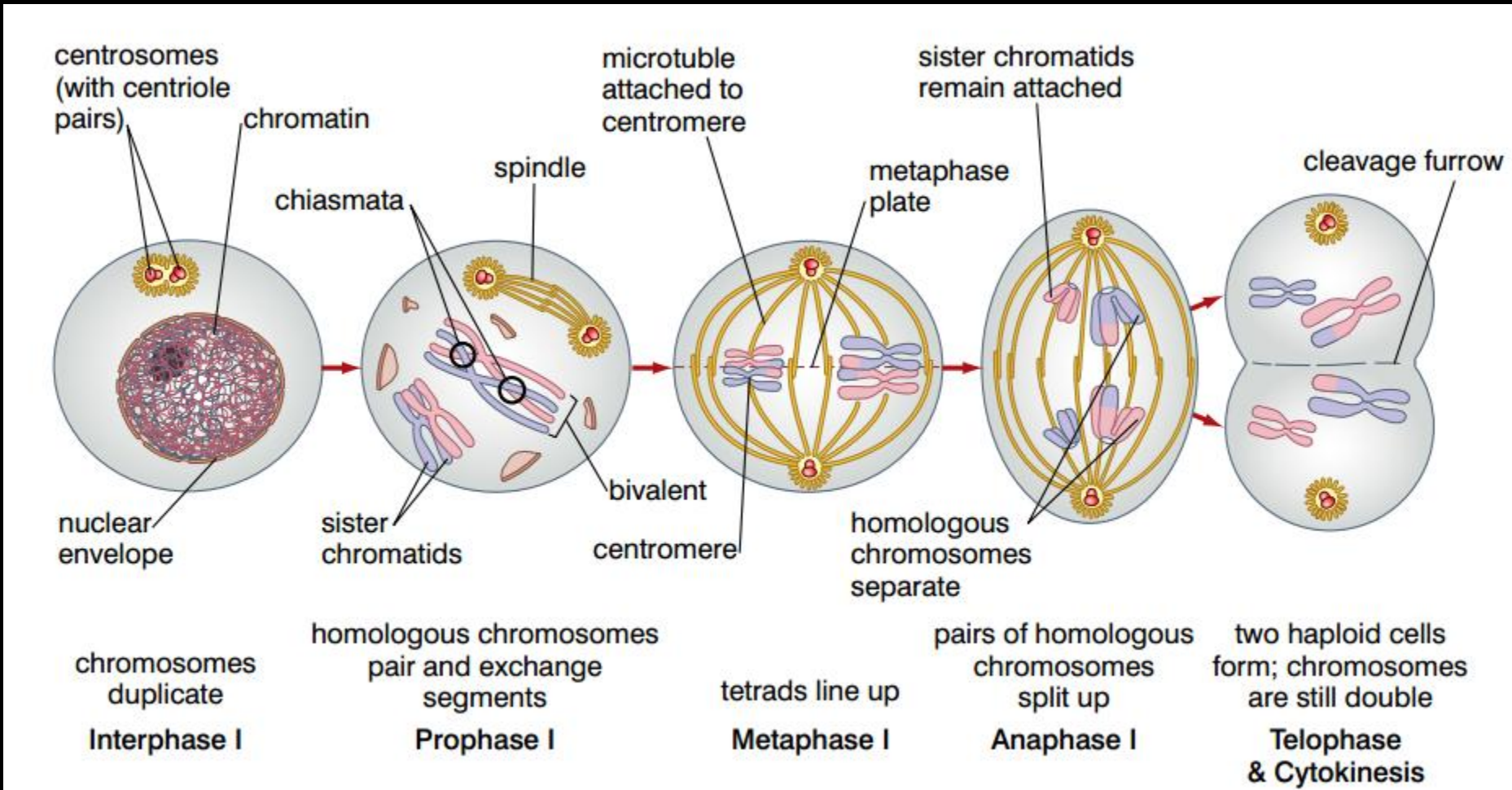
Prophase

metaphase

anaphase

telophase

Cont....



Cont...

main stages of meiosis II

- ❖ It is divided into the same four phases, but there are some important differences:
- ❖ There is no crossing over in prophase
- ❖ The chromosomes line up side by side in metaphase
- ❖ Chromatids are separated in anaphase

Cont...

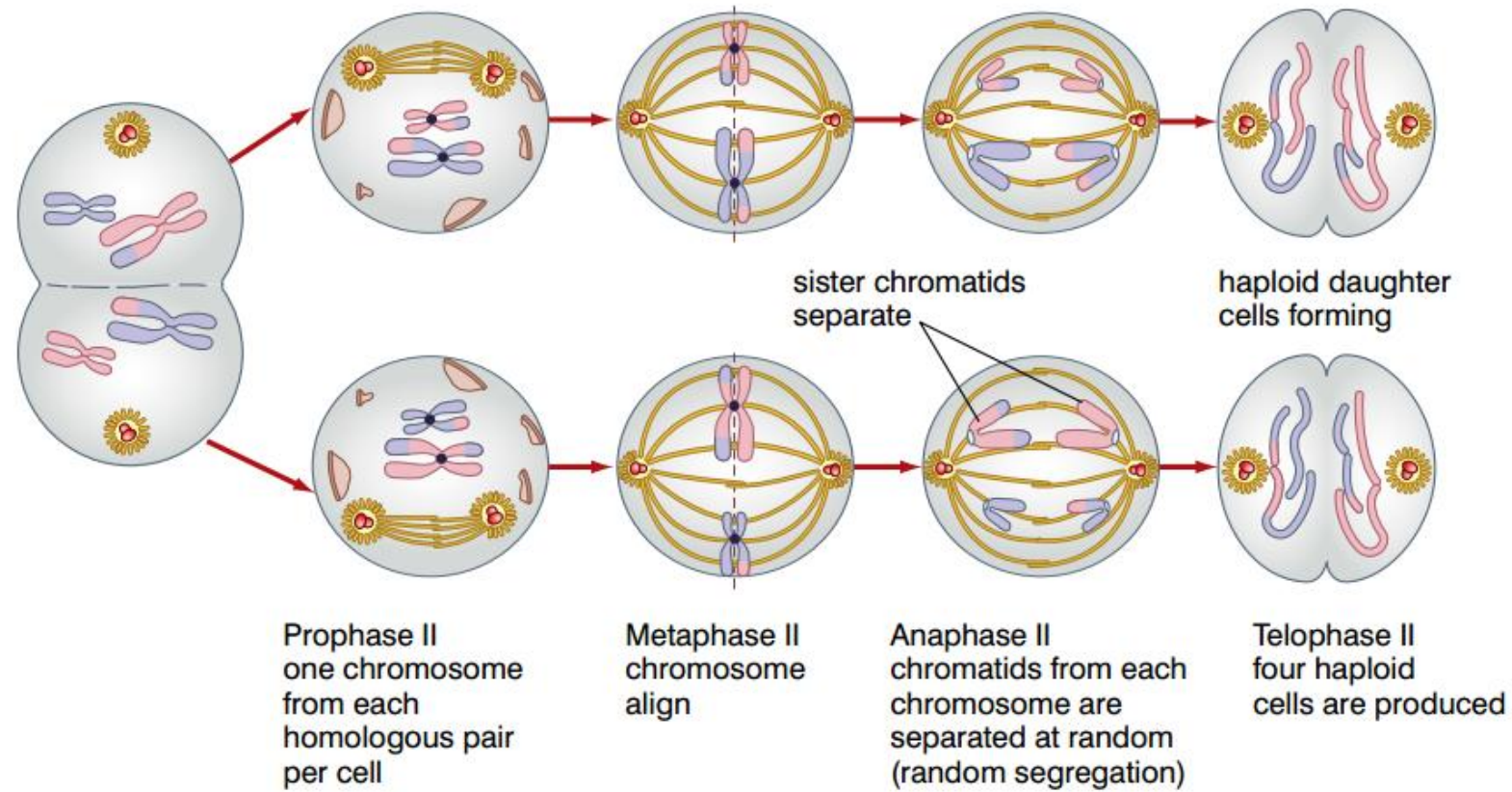


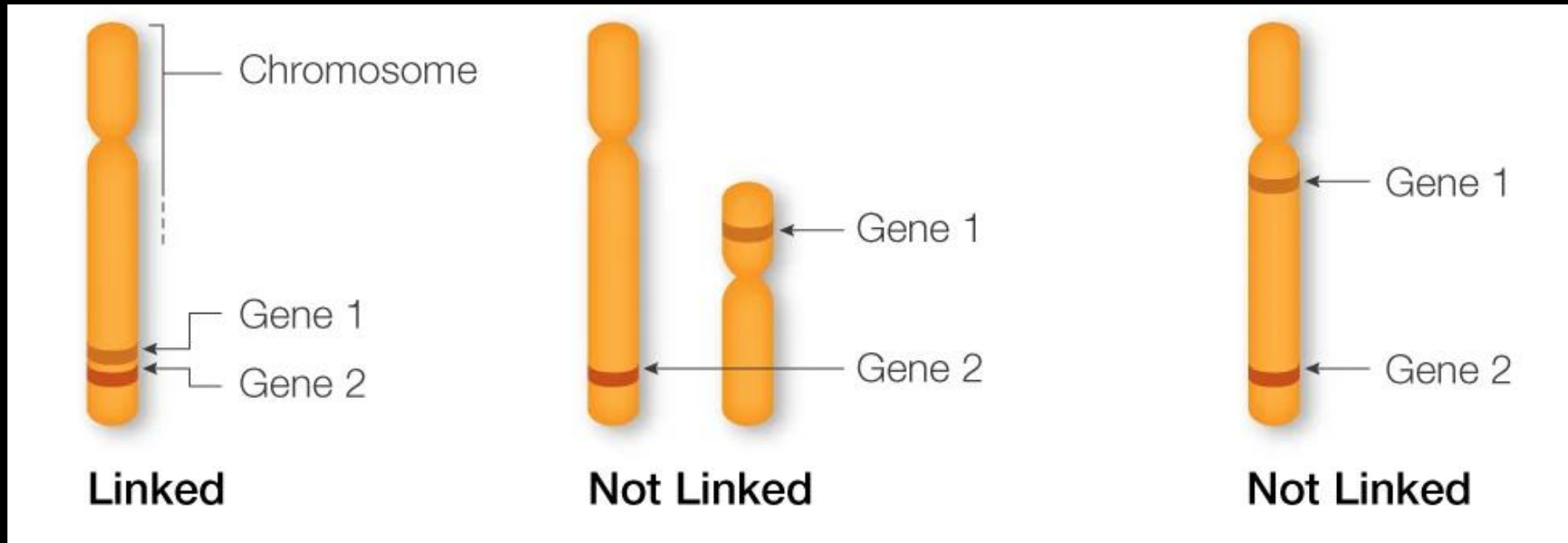
Figure 3.21 Meiosis II

What about alleles that don't segregate at gamete formation –genetic linkage

- ❖ All the alleles of all the genes involved in Mendel experiments dis segregate.
- ❖ But this does not always happen; some genes are always inherited together with other genes – they exhibit linkage. This happens when the genes in question are on the same chromosome.
- ❖ The genes that situated on the same chromosomes are termed as **linked gene**

cont.....

- ❖ Linked genes sit close together on a chromosome, making them likely to be inherited together .
- ❖ Genes on separate chromosomes are never linked (center).



How is knowledge of genetics important in crossbreeding and inbreeding crops and stock?

Selective breeding

- ❖ Both cross-breeding and in breeding are aspects of the same process – selective breeding
- ❖ selective breeding is the choosing and breeding together of organisms for better outcome
- ❖ It involves inbreeding and outbreeding(cross breeding)

Cont.....

Inbreeding

- ❖ When a new variety of a species is established, organisms of that type are often bred only with each other. This is called inbreeding
- ❖ **Inbreeding** is the breeding together of related varieties of a species generation after generation
- ❖ Inbreeding
 - it helps to produce a pure line
 - Increases homozygosity
 - Reduced fertility
 - Reduced disease resistance
 - Overall reduction in productivity

Cont.....

Cross breeding

- ❖ **Cross breeding**-is the breeding together of unrelated lines/breeds/variety of the same traits
- ❖ Commercial cattle farmers may cross-breed animals for two related reasons:
 - to take advantage of **hybrid vigour**
 - to take advantage of the good qualities of two or more breeds and to combine these qualities to improve market suitability
- ❖ Hybrid vigour occurs when unrelated breeds or lines (of the same species) are cross-bred

Cont.....

- ❖ Advantage of Cross breeding

 - Increasing heterozygosity

 - Increasing productivity and disease resistance

- ❖ Example if two crop (one high yielding but less resistant to disease and the other is less yielding but more resistant) are crossed together a crop with high yield and better resistance may be obtained

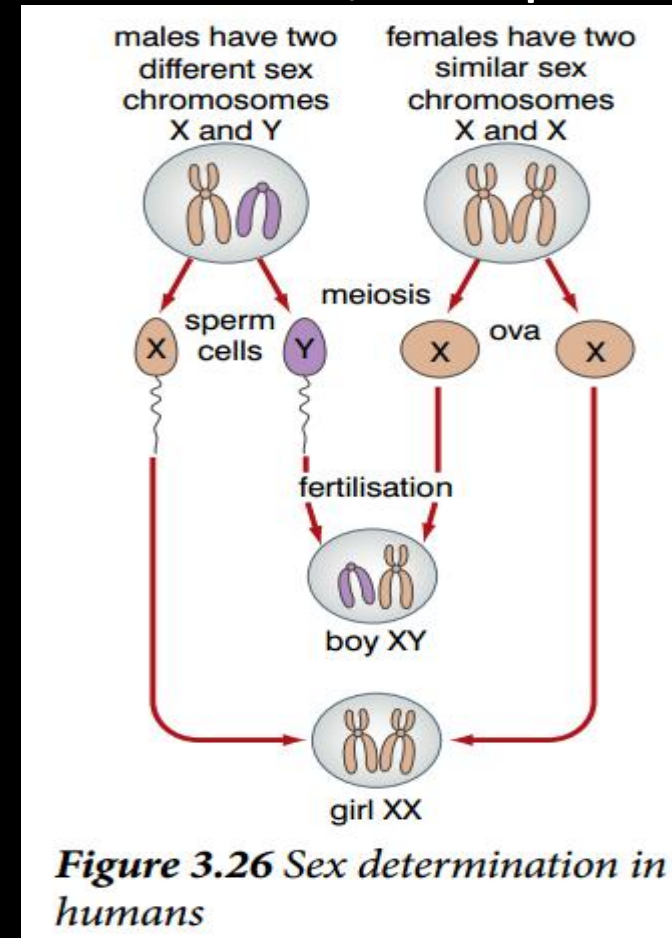
What about genes on the sex chromosomes?

More about sex determination

- ❖ Man has 46 chromosomes in his/her cell. two of this are sex chromosomes and 44 are autosomes(non-sex chromosomes)
- ❖ Males have one X chromosome and one Y chromosome, whereas females have two X chromosomes.
- ❖ Because males have two different sex chromosomes, they are called the heterogametic sex, whereas females are the homogametic sex.

Cont....

- ❖ in any family, or in any mating in mammals, the predicted ratio of males to females is 1:1



Cont....

- ❖ The Y chromosome that appears to determine a person's sex, it is, in fact, the action of one gene on this chromosome – the SRY gene– that determines the formation of testes.
- ❖ In the early development of the embryo, a region called the urogenital ridge develops into a 'bi-potential gonad'. This means that the same structure can develop into either ovary or testis.

Cont.....

- ❖ When the SRY gene is activated, the bi-potential gonad develops into a testis, and the embryo is male.
- ❖ If the SRY gene is absent (or inactivated for some reason), genes on the X chromosome and on the autosomes cause the bi-potential gonad to develop into an ovary, and the embryo is female

Cont.....

- ❖ Because it is the presence or absence of the SRY gene that determines sex, individuals with only one X chromosome and no Y chromosome (written X-) develop into females, but with slightly masculinized features.
- ❖ Similarly, individuals with two X chromosomes and one Y chromosome (XXY) develop into males, but with feminized features. These individuals are also sterile.
- ❖ The abnormal number of chromosomes arises as a result of nondisjunction of the sex chromosomes during meiosis. This means that the chromosomes do not segregate properly into the gametes,

Cont.....

The genes on the sex chromosomes

- ❖ Genes that are found only on the X chromosome or on the Y chromosome are said to be sex-linked.
- ❖ Genes found only on the Y chromosome include those that determine:
 - one form of the degenerative condition retinitis pigmentosa (in which eyesight becomes progressively weaker and may lead to blindness)
 - one form of deafness
- ❖ These particular conditions can only be inherited by males, as only males have the Y chromosome.

Cont.....

- ❖ Genes found only on the X chromosome include those that determine:
 - red-green colour blindness
 - one form of haemophilia
- ❖ These conditions can be inherited by females and males as both possess at least one X chromosome.

Cont.....

- ❖ Many of these conditions are determined by recessive alleles, including both red-green colour blindness and hemophilia. If you think about this carefully, you will see why it is that these conditions are more common in men than in women:
 - ✓ men only have one X chromosome •
 - ✓ if this chromosome carries the recessive allele for hemophilia, there is no corresponding dominant allele on the Y chromosome to mask its effect

Cont.....

- ❖ women have two X chromosomes
- ❖ both these need to carry the recessive allele for hemophilia for a woman to suffer from the conditions as, if only one of them did, the dominant allele on the other X chromosome would mask its effects
- ❖ a man needs to inherit only one X chromosome with a recessive haemophilia allele to suffer from the condition, whereas a woman must inherit two; this is less likely to happen

Cont.....

What are sex-influenced and sex-limited traits?

❖ **Sex-influenced trait** a is more likely to occur in one sex but may sometimes occur in the other sex

Example-Pattern baldness (often called male pattern baldness) is an example of a sex-influenced trait

❖ **sex-limited trait** a occurs only in one sex and never occurs in the other sex

Example-Sex-limited traits are only expressed in one sex. Both males and females have genes that stimulate lactation, but these are only expressed in females

THE END
THANK YOU

Molecular genetics

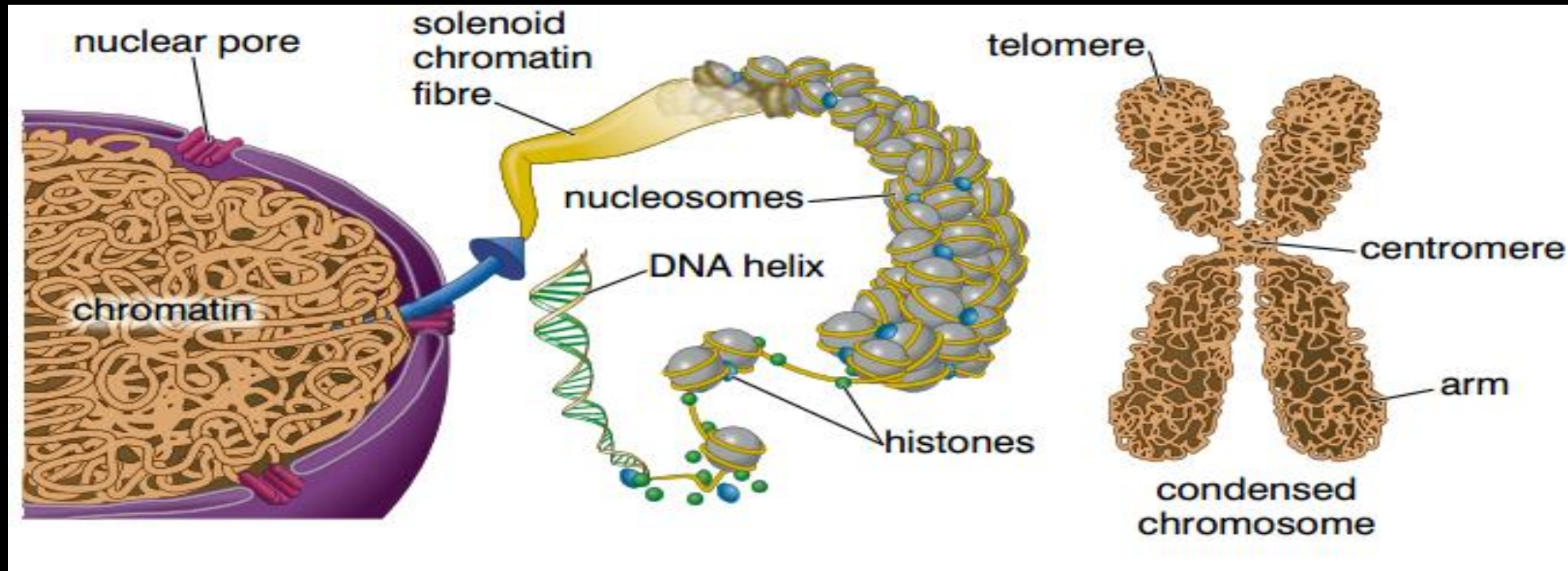
What is a chromosome really like?

Chromosomes are made from two chemicals:

DNA (deoxyribonucleic acid) and
histones (a set of globular proteins)

- ❖ DNA(deoxyribonucleic acid) is the molecule that stores genetic information
- ❖ Histone is the core of a chromosome around which the chromosome's DNA is wrapped

Cont.....



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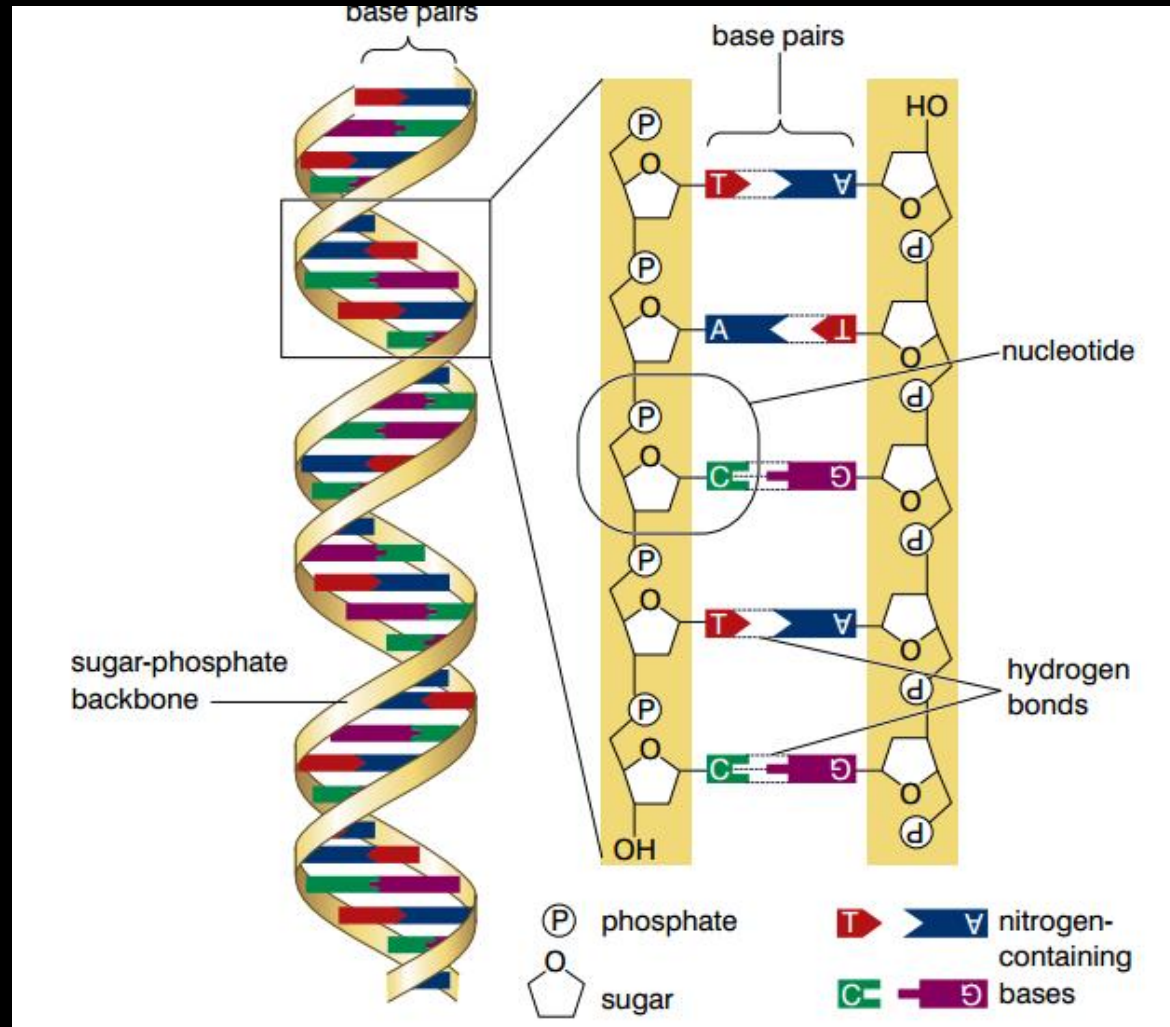
- ❖ DNA molecule wraps itself around the histone molecules to form a fiber of **chromatin**
- ❖ **Chromatin** is the loose form taken by a chromosome when the cell is not dividing
- ❖ When a cell is not dividing, the chromatin is loosely organized hence Individual chromosomes cannot be distinguished
- ❖ The 'loose' organization allows the genes to be active
- ❖ chromatin loops become compacted or 'condensed' to form a chromosome

Cont.....

How is a molecule of DNA put together?

- ❖ DNA – Deoxyribo-Nucleic Acid is one of two types of nucleic acids. The other is RNA– Ribo-Nucleic Acid.
- ❖ it is made of two strands joined together and wound into a **double helix**.
- ❖ **double helix** describes the structure of a DNA molecule. It consists of two anti-parallel polynucleotide strands
- ❖ The two strands are 'anti-parallel'.

Cont.....



Cont.....

❖ The basic unit of a DNA strand is a nucleotide. There are four types of nucleotides. These are:

Adenine-containing nucleotide

Guanine-containing nucleotide

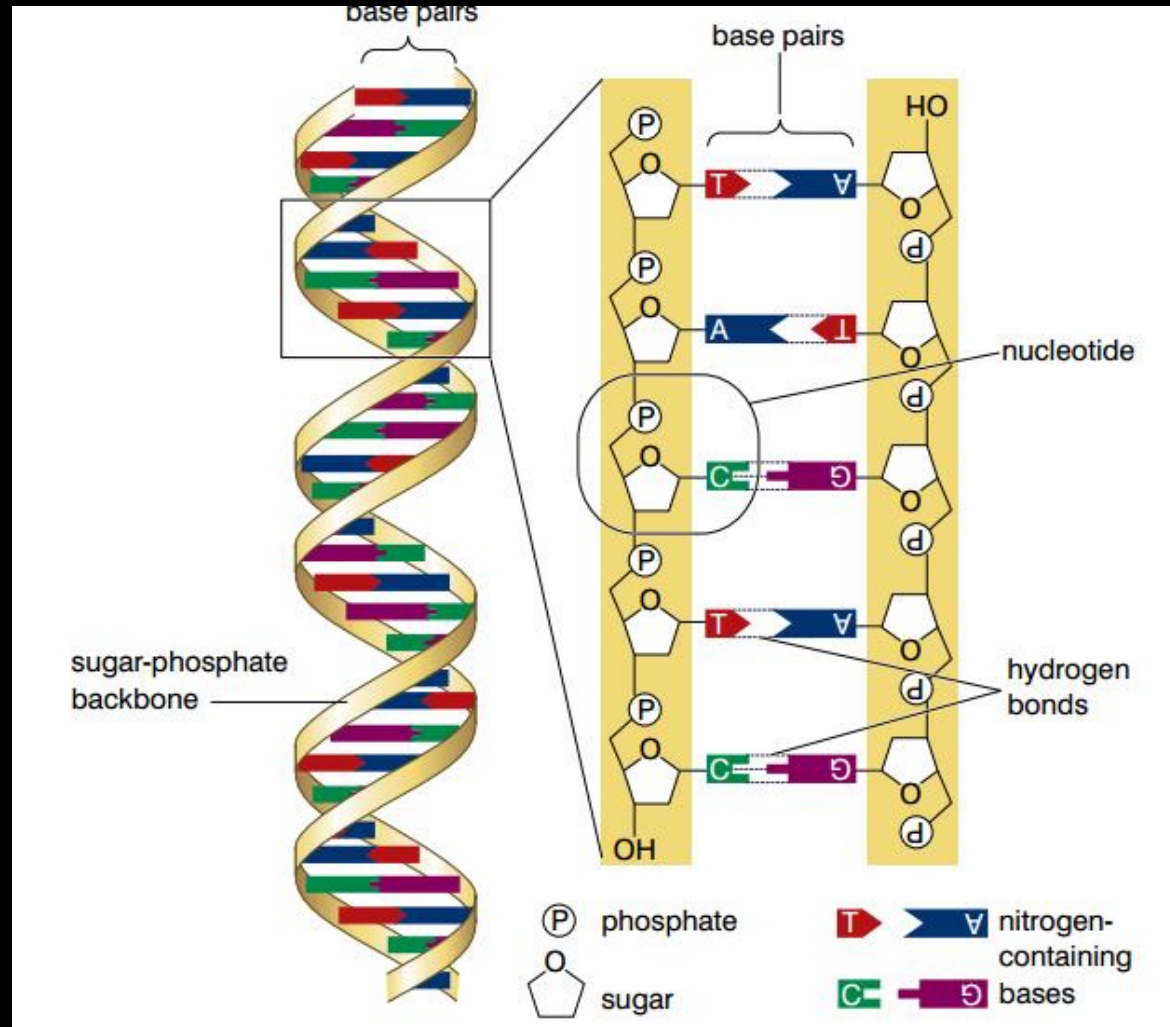
Cytosine-containing nucleotide

Thymine-containing nucleotide (in DNA, or Uracil-containing nucleotide in RNA).

Cont.....

- ❖ all nucleotides have the same three components:
 - a phosphate group
 - a pentose sugar (deoxyribose in DNA nucleotides and ribose in RNA nucleotides)
 - one of four nitrogenous bases – Adenine, Cytosine, Guanine and either Thymine (DNA) or Uracil (RNA)

Cont.....



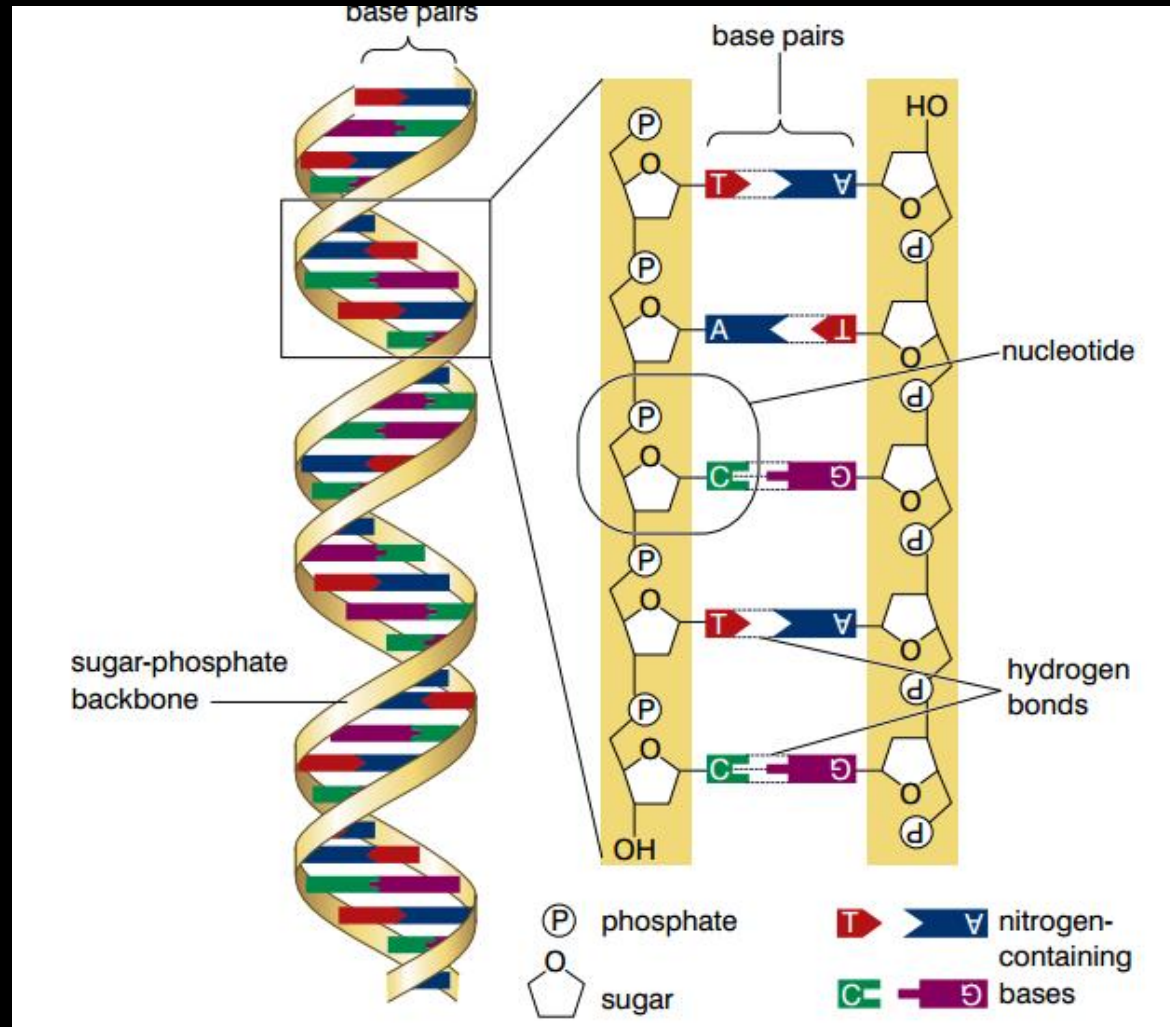
Cont.....

- ❖ DNA is a huge molecule made from two anti-parallel polynucleotide strands
- ❖ The nucleotides are held together by bonds between the sugar in one nucleotide and the phosphate group in the next. This bond is called **phosphodiester bond**
- ❖ The base does not take in this linking of the nucleotides in a strand.

Cont.....

- ❖ The nucleotides in one strand are paired with nucleotides in the other according to the base-pairing rule. This states:
 - Adenine-containing nucleotides will always be opposite Thymine-containing nucleotides
 - Cytosine-containing nucleotides will always be opposite Guanine-containing nucleotides

Cont.....



Cont.....

- ❖ The sequences of bases on the two strands are complementary.
- ❖ The individual hydrogen bonds that hold the two strands together are quite weak, but the sheer number of them in the whole molecule ensures that the two strands stay in position.
- ❖ The bonds that hold the nucleotides together in each strand are much stronger than the hydrogen bonds.
- ❖ The stability of the DNA molecule is important in ensuring that the genetic code – held in the DNA molecule – does not become corrupted in any way.

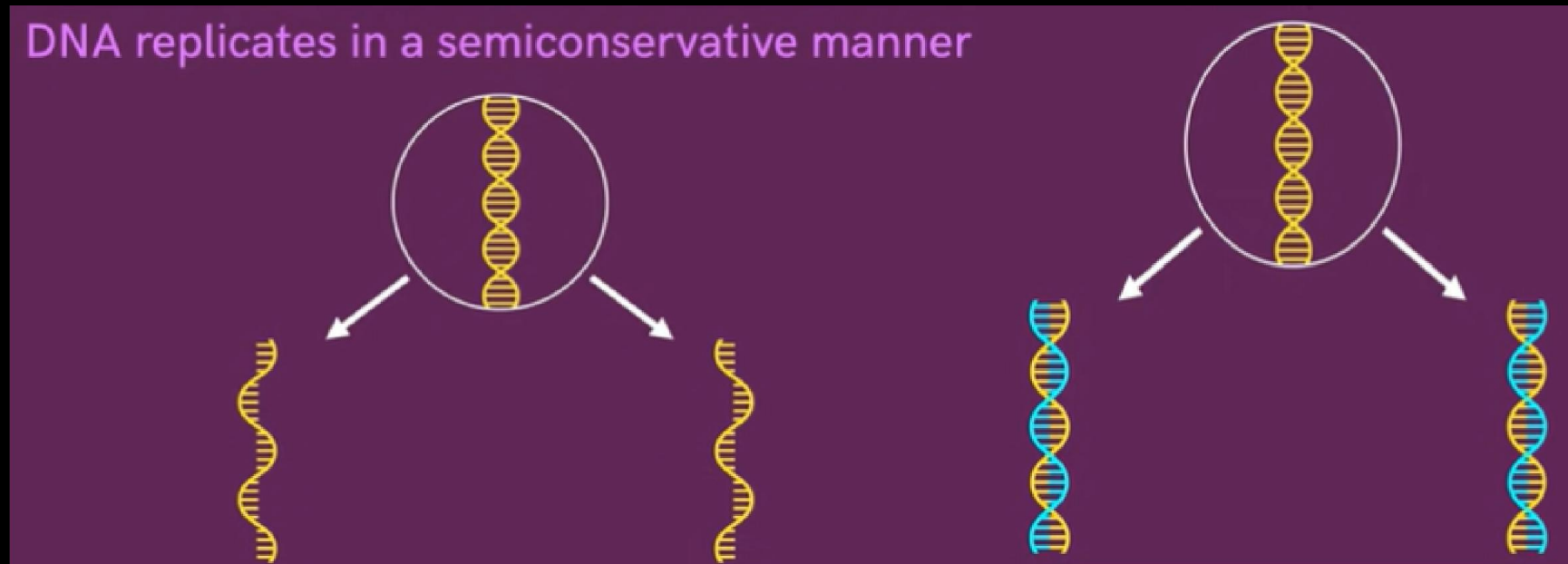
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How does the DNA molecule replicate itself?

- ❖ The ability of a DNA molecule to make an exact copy of itself is the basis of all methods of reproduction and the basis of passing on genetic information from one generation to the next.
- ❖ in 1953, Watson and Crick proposed that DNA must replicate semi-conservatively.

Cont.....

- ❖ **semi-conservatively** state that the newly formed DNA molecules contain one strand from the old and second from the newly synthesized



Cont.....

Has two main steps

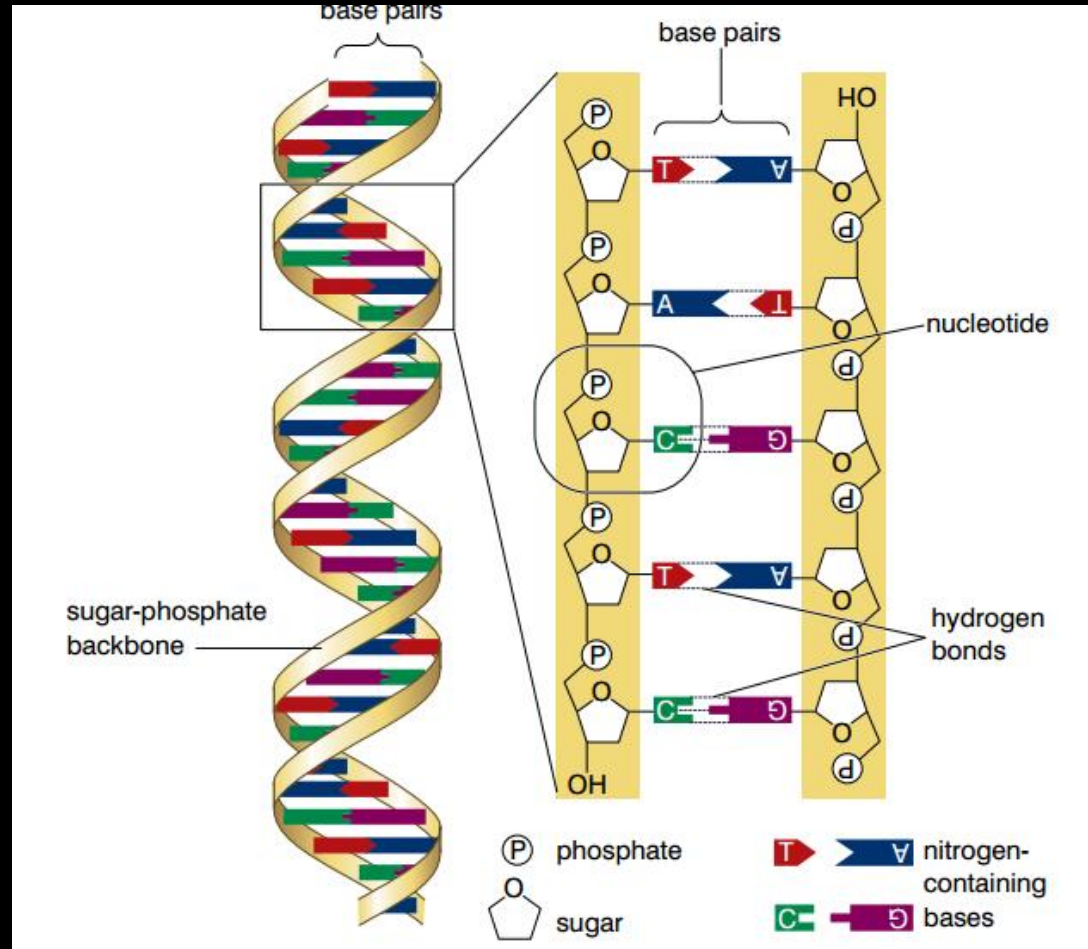
- ❖ **Unzipping (opening)**-an enzyme called **DNA helicase** break hydrogen bonds between the base to open the DNA helix and form single stranded region
- ❖ **Polymerization** here the **DNA –polymerase** assembly new strand from nucleotides in the cell using the old strand as a template. The new strand is complementary to the old one .
- ❖ Then the daughter DNA molecules are twisted in to the helix

Cont.....

DNA helicase the enzyme that initiates the separation of the polynucleotide strands during DNA replication

DNA polymerase the enzyme that initiates the building of a new complementary polynucleotide strand of DNA following separation of the original two strands

Cont.....



BIOLOGY GRADE 12

GENETICS

PART 6

HOW ORGANISM ARE CLONED

GENETIC ENGINEERING

Cont.....

How are organisms cloned?

Gene cloning is the process of making exact copies of a gene.

❖ It can be done in two ways

- 1) **In vivo cloning**- is the situation in which the gene is introduced in to the living cell and is copied many times as the cell divides
- 2) **In vitro cloning** is the use of a machine called polymerase chain reaction PCR to duplicate DNA . This is faster and cheaper and it mimics the semi-conservative replication of DNA that occurs in cells

Cont.....

- ❖ Cloning of organism is the reproduction of identical organism by asexual reproduction.
- ❖ The resulting offspring are genetically identical to each other and to their parent
- ❖ Clone is a group of genetically identical organism produced by cloning

Cont.....

- ❖ The first mammal to be cloned, and still the most famous, was **Dolly the sheep**.
- ❖ Dolly's genetic mother was a type of sheep called 'Finn-Dorset'.
- ❖ Dolly was produced by transferring a diploid nucleus to an egg cell that had been enucleated (had its nucleus removed).

Cont.....

What is genetic engineering ?

- ❖ **Genetic engineering** is a process in which the genome of an organism is altered, usually by having an extra gene from a different organism added.
- ❖ The organism is then a genetically modified or a transgenic organism
- ❖ **genetically modified organism** an organism created using genetic engineering which contains a transferred gene or genes
- ❖ **transgenic organism** a genetically modified organism that contains a gene or genes transferred from another organism belonging to a different species

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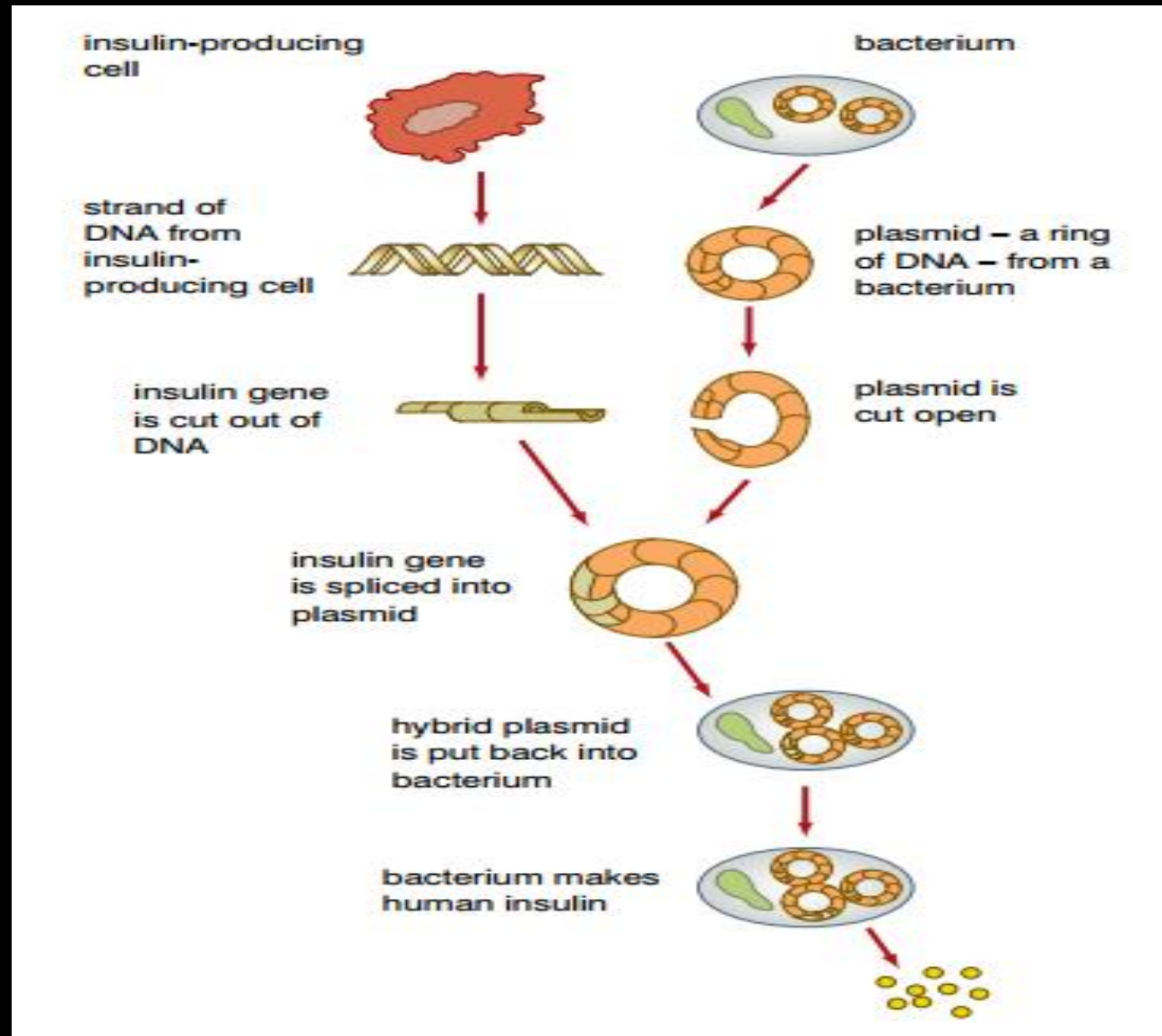
- ❖ Much of the early work on genetic engineering was done to genetically modify bacteria because easier to handle them.
- ❖ The gene that controls the production of human insulin was extracted from human pancreas cells and transferred to the bacteria
- ❖ The insulin they produced is extracted ,purified and used to treat diabetic patients.
- ❖ Enzyme for different purpose, human growth hormone and vaccine can also be produced by this transgenic bacteria

Cont.....

Main steps of genetic engineering

- ✓ Cutting out the gene of interest from the donor DNA by using an enzyme called restriction endo nuclease
- ✓ Extracting plasmids from a bacterium and opening it by restriction endo –nuclease
- ✓ Inserting and typing (silencing) the gene of interest Into the plasmid using the DNA ligase
- ✓ Introducing the hybrid (recombinant) plasmid into suitable bacterium
- ✓ Extracting, purifying and utilizing the gene product (ex- insulin, enzyme) released by the recombinant bacterium

Cont.....



Cont.....

❖ Genetically modified bacteria produce a range of products, including:

- Enzymes for the food industry
- Thermostable enzymes for washing powders
- Human insulin
- Human growth hormone
- Vaccines (for example, for prevention of hepatitis B)
- Bovine somatotrophin (to increase milk yield and muscle development in cattle)

Cont.....

- ❖ Plant can also be genetically modified to increase their yield and disease resistance .
- ❖ Transgenic plant can also produce specific products (for example, **golden rice** is genetically modified rice that produces **beta-carotene** – important in the formation of vitamin A, which prevents night blindness)

Cont.....

Potential benefits of Genetic engineering

- ✓ Disease prevention by detection of hereditary diseases susceptibility
- ✓ Treatment of viral disease by the transfer of anti viral protein coding gene
- ✓ Genetically engineered plants and animals can be produced to give increased growth rates and reduced susceptibility to disease.
- ✓ Genetically engineered may absorb more CO₂ to reduce global warming

Cont.....

- ✓ Genetic engineering could increase genetic diversity, and produce more variant alleles
- ✓ Genetic engineering is a much quicker process than traditional selective breeding.

Cont.....

How can gene technology be used in forensic science?

- ❖ **Genetic fingerprinting** a forensic technique that is used to try to solve crimes by matching DNA found at crime scenes with the DNA of suspects
- ❖ Generally the DNA categorized into **coding** and **non-coding region**
- ❖ The **coding region** represent gene
- ❖ The **non coding region** are made up of short sequence of repeating base
- ❖ The non-coding DNA is found between genes and contains base sequences that are repeated, sometimes many times over.
- ❖ These repeating sequences of non-coding DNA are called **mini-satellites**

Cont.....

The main stages in preparing a genetic fingerprint are as follows:

- ❖ DNA is isolated from the cells
- ❖ DNA fragmentation by restriction enzymes and treatment by alkali to get single-stranded DNA
- ❖ The fragments are separated by gel electrophoresis. Smaller fragments (with a lower molecular mass) move further than larger fragments
- ✓ **Gel electrophoresis** is the technique of separating DNA fragments by applying electric field across the gel

Cont.....

- ❖ The (invisible) pattern of separated DNA fragments is transferred from the gel to a nylon membrane. The membrane is placed over the gel in a tray of 'flow-buffer' and is held in place by paper towels and a weight. The buffer soaks up through the gel, carrying the fragments of DNA with it. The buffer can pass through the membrane (to be absorbed by the paper towels), but the DNA cannot
- ❖ A radioactive gene probe is applied to the membrane. This is made of single-stranded DNA (called c-DNA) and binds with base sequences in the mini-satellite regions
- ❖ The membrane is placed over a piece of X-ray film to reveal the positions of those fragments that have bound to the probe.

Cont.....

Protein synthesis

- ❖ Protein are essential molecules in our body that determine our characteristics.
- ❖ They act as hormones, enzymes, structural material and cell markers
- ❖ Their production needs flow of information from DNA in the nucleus to ribosomes in the cytoplasm .
- ❖ Ribosomes are factories where proteins are manufactured

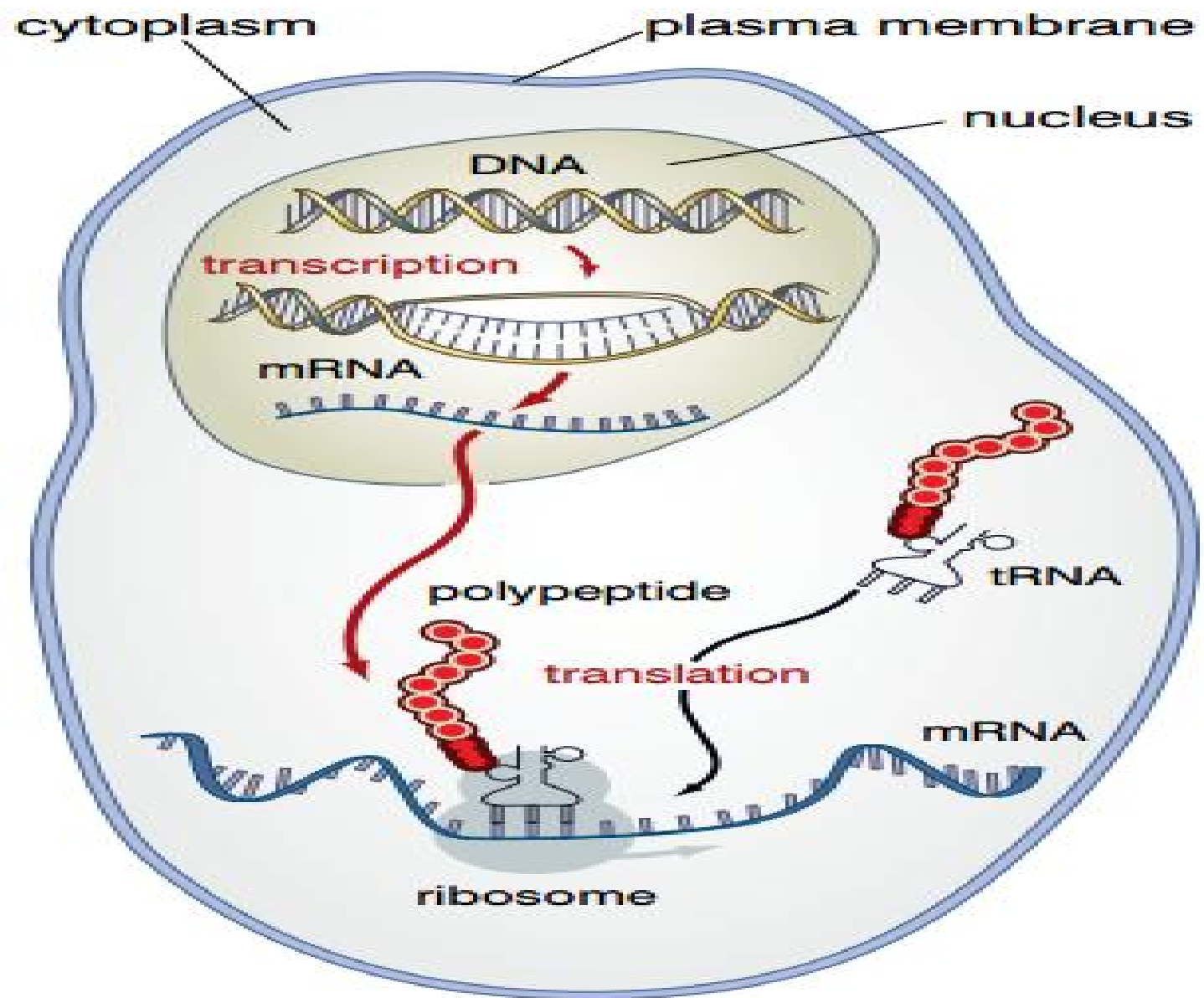
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The following events occur during Protein synthesis:

- The DNA code for the protein is rewritten in a molecule of **messenger RNA(mRNA)**; this rewriting of the code is called **transcription**.
- ✓ **mRNA (messenger RNA)** is a nucleic acid that transmits the genetic code from DNA to ribosome
- ✓ **Transcription** is the process that converts genetic information from a DNA code into an mRNA code
- The mRNA travels from the nucleus through pores in the nuclear envelope to the ribosomes.

Cont.....

- Free amino acids are carried from the cytoplasm to the ribosomes by molecules of **transfer RNA(tRNA)**.
- ✓ **tRNA(transfer RNA)** transfers individual amino acids during translation
- The ribosome reads the mRNA code and assembles the amino acids carried by tRNA into a protein; this is called **translation**.
- ✓ **Translation** is the process in which the mRNA code is converted into a sequence of amino acids



Cont.....

What is the genetic code like?

- ❖ **Genetic code (gene)** is the sequence of base triplets in the DNA molecule that carries information for a polypeptides(protein).
- ❖ This gives us a useful definition of a gene:
- ❖ **A gene** is a sequence of base triplets in the DNA molecule that carries the code for a protein.
- ❖ The genetic code is held in the DNA molecule.

Cont.....

- ❖ With four different bases to work with (adenine, thymine, cytosine and guanine), there are 64 possible triplet codes, but only 20 amino acids are used to make all the different proteins.
- ❖ Most amino acids have more than one code. Only **methionine** and **tryptophan** have just one triplet that codes for them; arginine has six
- ❖ Three of the triplets (TAA, TAG and TGA) do not code for amino acids at all. They are 'stop' codes that signify the end of a coding sequence.

Cont.....

- ❖ Only one of the strands of the DNA molecule carries the code for proteins. This is called the **coding strand** or **the sense strand**. The other strand is the **non-coding or antisense strand**.
- ❖ **non-coding or antisense strand** is the DNA strand used to synthesizing mRNA
- ❖ The other complementary strand is called **the sense strand**

Cont.....

Properties of genetic code

- ❖ Genetic code is a **triplate code**-that consists of a sequence of triplate or three bases
- ❖ Genetic code is **degenerate code** this means excess triplate codes than what is needed
- ❖ The Genetic code is a **non-overlapping code**. This means that each triplet is distinct from all other triplets.
- ❖ The genetic code is **a universal code** which means the same for all organisms ranging from bacteria to man

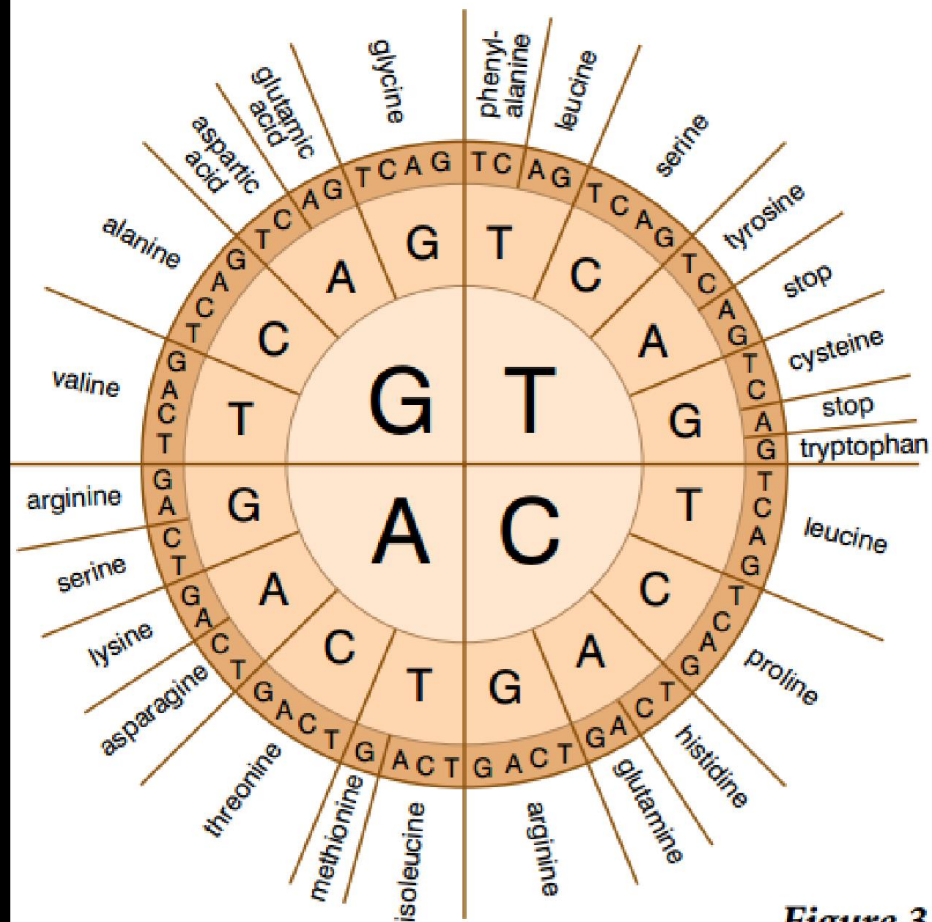


Figure 3.47A The genetic code

		second position				
		T	C	A	G	
first position	T	phenylalanine	serine	tyrosine	cysteine	T
		leucine		stop	stop	C
	C	leucine	proline	histidine	arginine	A
				glutamine		G
first position	A	isoleucine	threonine	asparagine	serine	T
		methionine		lysine	arginine	C
	G	valine	alanine	aspartic acid	glycine	A
				glutamic acid		G

Figure 3.47B Another way of representing the genetic code

Cont.....

How does transcription take place in eukaryotic cells?

- ❖ During this process, the coded information in the DNA of one gene is used to synthesise a molecule of mRNA that will carry the code to the ribosomes.
- ❖ mRNA is similar to DNA in that it is built from nucleotides;
- ❖ however, it is different from DNA in a number of ways:
 - ✓ It is a much smaller molecule
 - ✓ It is single stranded
 - ✓ The base thymine is replaced by uracil
 - ✓ The sugar in the nucleotides is ribose, not deoxyribose

Cont.....

Basic term

Code is refers to base triplate on DNA that code for amino acid or a stop information

Codon is The triplets of bases in mRNA that code for amino acids are called codons.

Anticodon is the base triplate in tRNA which is complementary to one of the codons on mRNA

Cont.....

- ❖ The mRNA codons are identical to the DNA triplets that code for specific amino acids, except that U (uracil) is substituted for T (thymine).
- ❖ To form the single-stranded mRNA when transcription takes place, only the antisense strand of DNA is transcribed.
- ❖ This is because the sense strand of this section contains the gene that codes for a protein

Cont.....

In eukaryotic cells, transcription takes place in the following way:

- ❖ The enzyme DNA-dependent RNA polymerase (RNA polymerase) binds with a section of DNA next to the gene to be transcribed.
- ❖ Transcription factors activate the enzyme.
- ❖ The enzyme begins to 'unwind' a section of DNA.
- ❖ RNA polymerase moves along the antisense strand, using it as a template for synthesising the mRNA.
- ❖ The completed molecule mRNA leaves or detaches from the DNA; the strands of DNA rejoin and re-coil.
- ❖ Synthesized mRNA comes out of nucleus and attaches to the ribosomes in the cytoplasm. Hence the transcription is completed

Cont.....

How does translation take place?

- ❖ Translation is the process by which the code (information) in mRNA is converted into protein
- ❖ Enzyme ,tRNA and ribosome are required for this process
- ❖ tRNA has a clover-leaf shape or (configuration)
- ❖ One end of tRNA always ends in G and the other end is CCA where the amino acids are attached
- ❖ The 'cloverleaf' configuration of the molecule has at one end a triplet of bases called an anticodon.

Cont.....

- ❖ **Ribosomes** are made from ribosomal RNA (rRNA) and proteins organised into a large and a small subunit.
- ❖ Within the ribosome, there are three sites that can be occupied by a tRNA molecule, called the A, P and E sites.
- ✓ **A site** where the amino acid enter
- ✓ **P site** where the peptide bond is formed between the amino acid
- ✓ **E site** where the freed tRNA and polypeptide bond is removed

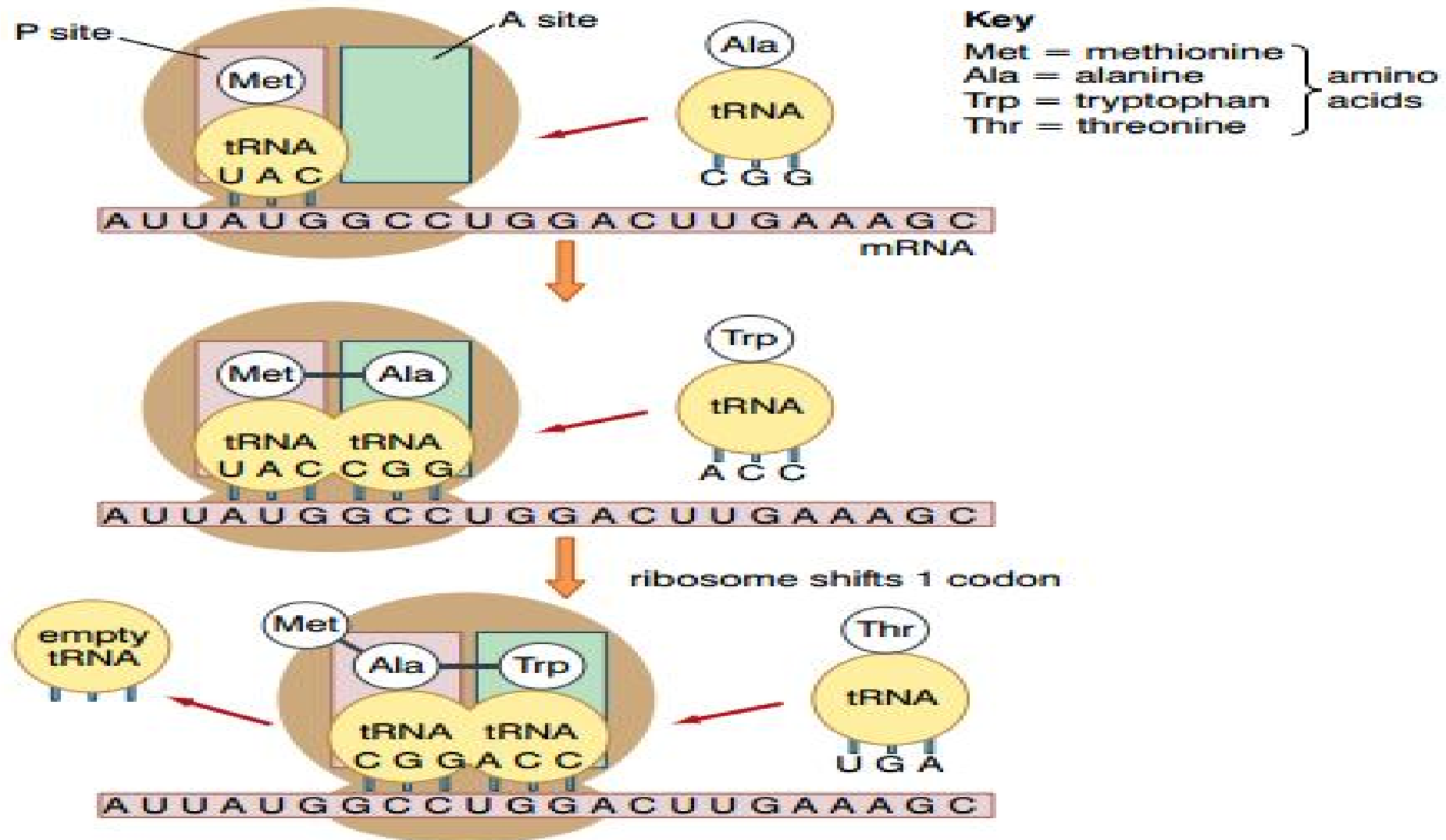
Cont.....

The following events take place:

- ❖ The first two codons of the mRNA enter the ribosome.
- ❖ Transfer RNA molecules (with amino acids attached) that have complementary anticodons to the first two codons of the mRNA bind to those codons.
- ❖ A peptide bond forms between the amino acids carried by these two tRNA molecules and the dipeptide is transferred to the tRNA in the A site.

Cont.....

- ❖ The ribosome moves along the mRNA by one codon, bringing the third codon into the ribosome; at the same time the 'free' tRNA exits the ribosome and the tRNA with the dipeptide moves into the P site
- ❖ A tRNA with a complementary anticodon binds with the third codon, bringing its amino acid into position next to the second amino acid.
- ❖ A peptide bond forms between the second and third amino acids. The ribosome moves along the mRNA by one codon, bringing the fourth mRNA codon into the ribosome, and the whole process is repeated until a 'stop' codon is in position and translation ceases



Cont.....

- ❖ The translation of the mRNA code into a protein molecule requires energy.
- ❖ However, this does not come from the hydrolysis of ATP as is usual in a cell, but from the hydrolysis of a similar molecule, GTP – Guanosine Triphosphate.

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Cont.....

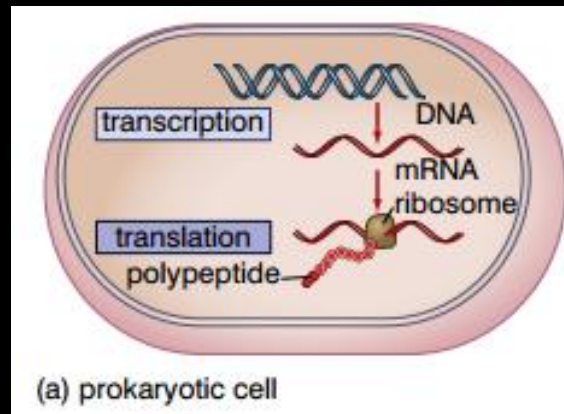
How is protein synthesis different in prokaryotic cells?

- ❖ The process is essentially similar in both types of cells, with DNA being transcribed to mRNA, which is then translated to a polypeptide chain.
- ❖ However, there are some differences and these are linked to the fact that

Cont.....

prokaryotic cells

- ❖ Prokaryotic cells do not have a nucleus
- ❖ Prokaryotic mRNA does not need post-transcriptional processing
- ❖ Transcription and translation are coupled; mRNA can be translated by ribosomes at one end of its molecule while it is still being transcribed from DNA at the other end



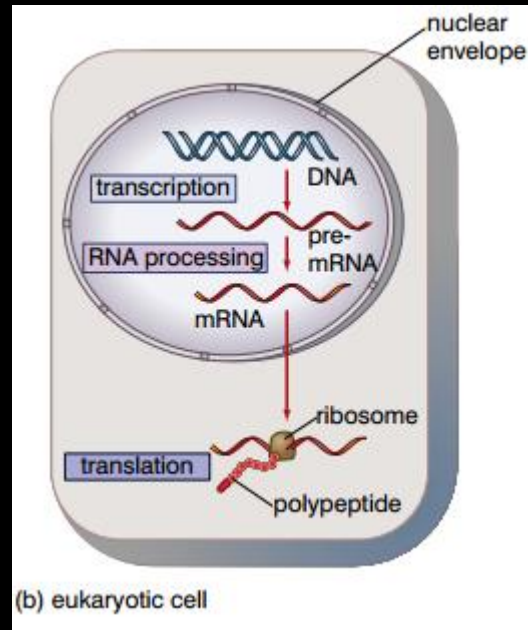
Cont.....

Eukaryotes: Transcription and translation are separated

Transcription occurs in the nucleus

Translation occurs in the cytoplasm

Eukaryotic mRNAs are modified before leaving the nucleus



Cont.....

What becomes of the proteins that are synthesized?

Type of protein	Example	Function of example
Structural	Collagen	Building fibres of cartilage
	Keratin	Building nails and feathers
Enzyme	ATP synthase	Producing ATP from ADP and P_i
	DNA helicase	Unwinding the double helix of DNA
Peptide hormone	Insulin	Control of plasma glucose concentration
	Adrenaline (epinephrine)	Fight or flight response
Antigen	A antigen on red cells	Determine blood group
	CD4	Allows binding of HIV to T-lymphocytes
Antibody	Anti-a antibodies	Causes clotting of red cells with A antigen
	HIV antibodies	Destroys some HIV antigens

- ❖ To synthesise these proteins continually, our bodies require a constant supply of amino acids.
- ❖ These we obtain from the protein in the foods we eat.

Cont.....

- ❖ As mentioned earlier, just 20 amino acids are used to make all the different proteins. Some of these can be made in our bodies by a process called transamination.
- ❖ Transamination is the transfer of the amino group of one amino acid to a keto acid
- ❖ In this process, the amino group of an amino acid is removed and transferred to a keto acid.

Cont.....

- ❖ Not all amino acids can be produced by transamination. There are some that we just have to obtain from our food. These amino acids are called **essential amino acids**
- ❖ **meat, fish, poultry, eggs** and **milk** are animal sources of protein that provide a good balance of essential amino acids.
- ❖ The best non-animal sources are **quinoa, buckwheat, hempseed** and **amaranth**, although these contain lower overall amounts of protein than some cereals (wheat, rice, maize) and nuts and pulses.

THE END
THANK YOU

BIOLOGY GRADE 12

GENETICS

PART 9

What controls gene expression?

Cont.....

What controls gene expression?

- ❖ Gene activity (expression) may depend on age and sex of the organism and or the site of the gene in the body
- ❖ Therefore not all genes are active always and anywhere
- ❖ Some gene are expressed at the childhood ,other at adult hood
- ❖ Example the gene that control color of our iris are found in all cell but expressed in iris cells only
- ❖ The gene controlling milk production in mammals are switched off during child and switched on at adult hood in females only

Cont.....

How are genes switched on?

- ❖ genes are switched on by 'transcription factors' that are present in the cell.
- ❖ These transcription factors are usually proteins that bind to a regulatory sequence of DNA near to the gene they influence

Cont.....

They operate in the following way:

- ❖ The transcription factors bind to a promoter sequence of DNA near to the gene to be activated.
- ❖ RNA polymerase binds to the DNA/ transcription factor complex
- ❖ The RNA polymerase is 'activated' and moves away from the DNA/transcription factor complex along the gene.
- ❖ The RNA polymerase transcribes the antisense strand of the DNA as it moves along; the gene is now being expressed.

Cont.....

How are genes switched off?

- ❖ Besides transcription factors that promote the expression of genes, other factors can act to repress gene action. One group of substances that does this is known as **short interfering RNA(siRNA)**
- ❖ **short interfering RNA** a short sequence of RNA which can be used to silence gene expression
- ❖ These RNA molecules are unusual because they are very short – only about 21 to 23 nucleotides long – and are double stranded.

Cont.....

- ❖ They don't act on the gene itself, but they 'interfere with' or 'silence' the mRNA once it has been transcribed from the DNA.

This is called **post-transcriptional interference**.

- ❖ If the mRNA is prevented from translating its codons into amino acids, then the protein for which the gene codes cannot be built. The gene has effectively been silenced

Cont.....

Biologists think that the action of siRNA is as follows:

- ❖ Double-stranded RNA (dsRNA) is produced in the nucleus from a range of genes.
- ❖ It is then split into the very short lengths that characterize siRNA by an enzyme called 'Dicer'.
- ❖ The antisense strand of the siRNA then binds with a complex of molecules called RISC.
- ❖ The siRNA binds with mRNA and allows RISC to degrade/cleave the mRNA into small fragments.

THE END

