



Free
Minds
Academy

DNA: The Code of Life

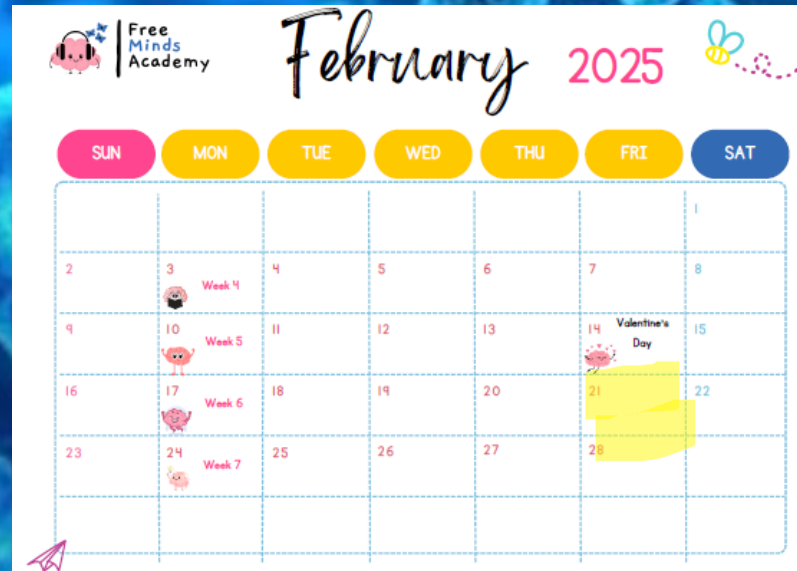
Dr Ross – Grade 12 – Term 1 – Life Science



ASSESSMENTS

**Practical:
21ST Feb 2025**

**Exam:
17th March 25**



GRADE 12 Year plan

Suggested Week	Topic, Paper and %	Content to be covered	Suggested Formal Activities	Date Completed and Signature
1	DNA: The code of Life P1 18%	Revision of cell structure; Nucleic acids: Location of DNA; Discovery of DNA		
2		DNA structure & role, genes; DNA replication, DNA profiling		
3		RNA: Types, location and structure; Protein Synthesis (Transcription & Translation)		
4	Meiosis P1 14%	Cell structure; structure of chromosomes; Differentiation of cells; Review of mitosis; Process of meiosis (events of various phases)		
5		Importance of Meiosis; Abnormal meiosis; Comparison of Mitosis and Meiosis (Similarities and differences)		
6	Reproduction in Vertebrates P2 5%	Diversity of reproductive strategies: Internal- and external fertilisation, vivipary, ovipary, ovovivipary, amniotic egg, precocial- and altricial development, parental care		
7	Human Reproduction P2 27%	Male and female reproductive structures; puberty; spermatogenesis, sperm		
8		Oogenesis, ovum; ovarian cycle		
9		Uterine cycle; menstruation cycle; fertilization; gestation, role of the placenta		MARCH EXAM
10	Genetics and Inheritance P1 32%	Genes, Mendel; Concepts in inheritance and variation; Genes; Monohybrid crosses		
11		Types of dominance; Sex determination; Sex linked inheritance & disorders		
12		Blood grouping; Dihybrid crosses; Pedigree (genetic lineages)		
13		Mutations; Genetic engineering; Paternity testing, DNA profiling and -fingerprinting, Genetic links, chromosomal deviation, stem cells, GMO's, biotechnology, cloning		
14	Humans: Responding to environment P2 36%	Human nervous system: CNS (Brain and spinal cord)		
15		Human nervous system: Peripheral nervous system, Autonomic nervous system, neurons; reflex arc; disorders, injuries, drugs.		
16		Receptors: Human Eye (structure, function, binocular vision, accommodation, pupillary reflex, diseases); Human Ear (structure, functions, hearing, balance, disorders)		JUNE EXAM
17		Examination		
18		Examinations		
19		Examinations		
20		Examinations		
21	Human Endocrine System and Homeostasis P2 23%	Human Endocrine system: Endocrine glands (location, hormones, roles)		
22		Negative feedback: TSH and Thyroxine; Insulin and Glucagon; glucose, carbon dioxide, water, salts;		
23		Temperature regulation (adaptations of human skin), diabetes		
24	Plants: Responding to the environment P2 9%	Plant hormones; Geotropism & phototropism; Defensive mechanisms		
25	Evolution by Natural Selection and Human evolution P1 36%	Evidence for Evolution; Variation; Historical development; Lamarckism, Darwinism		
26		Punctuated equilibrium; Artificial selection, Speciation, Reproductive isolation, Evolution in present times		
27		Evidence for Human Evolution; Similarities and differences between Humans and the African Apes		
28		Out of Africa hypothesis		SEPT EXAM
29		Trial examinations		
30		Trial examinations		
31		Trial examinations		
Until exams	Revision			
	External examinations			



1: DNA – the code of life

Introduction

Revision of cellular structure

The structure of nucleic acids

DNA – deoxyribonucleic acid

A brief history of the discovery of DNA

The location of DNA

The structure of DNA

The role of DNA

Activity 1: DNA

RNA – ribonucleic acid

The location of RNA

The structure of RNA

The role of RNA

Comparison between DNA and RNA

DNA replication

Errors that occur during DNA replication

Activity 2: DNA replication

DNA profiling

Activity 3: DNA profiling

Protein synthesis

Protein synthesis occurs in two stages

Stage 1: Transcription

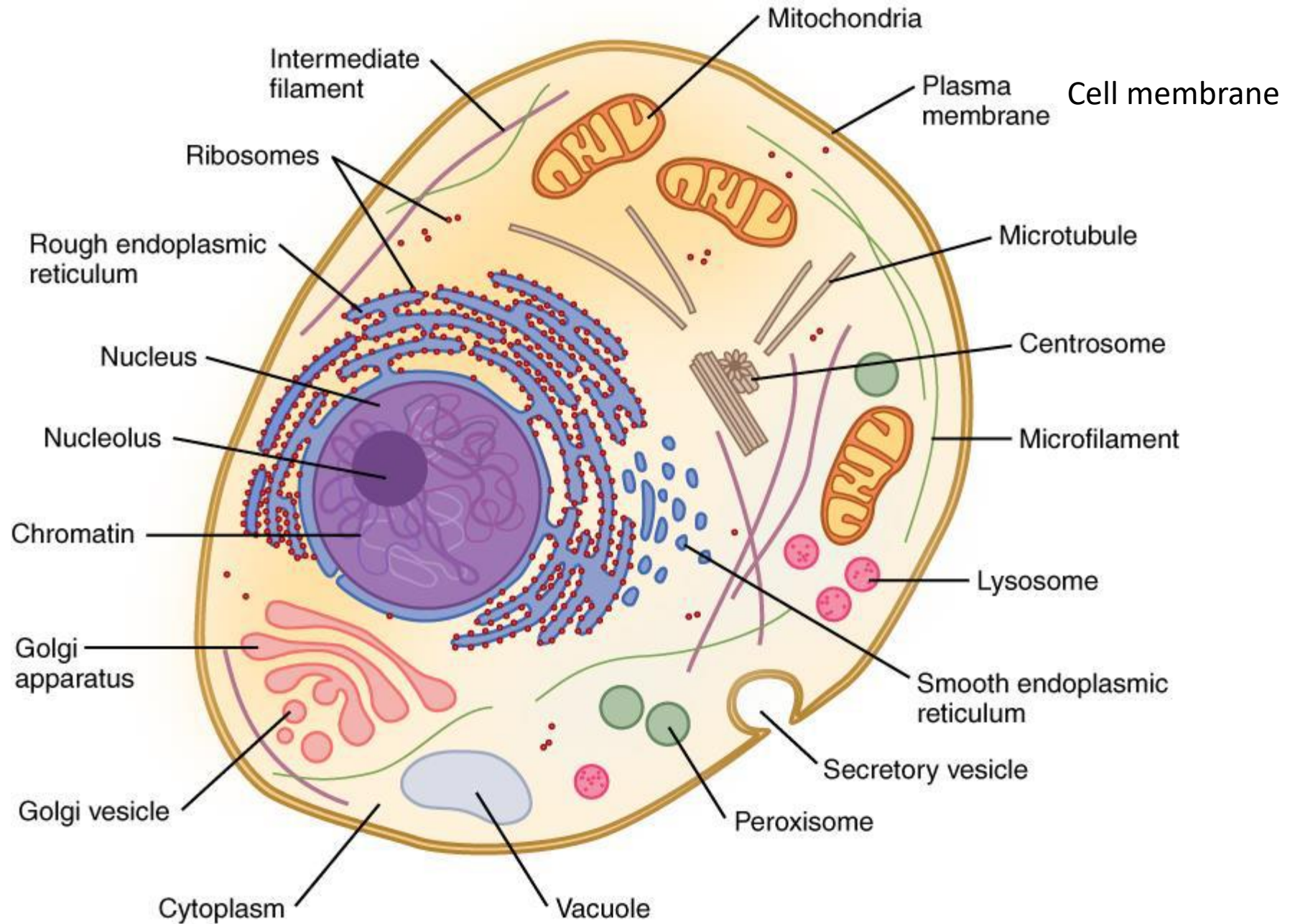
Stage 2: Translation

The effect of mutation on protein structure (DNA sequence)

Activity 4: Protein synthesis

Activity 5: Codons and amino acids

End of topic exercises



It is important to know the location and functions of certain organelles

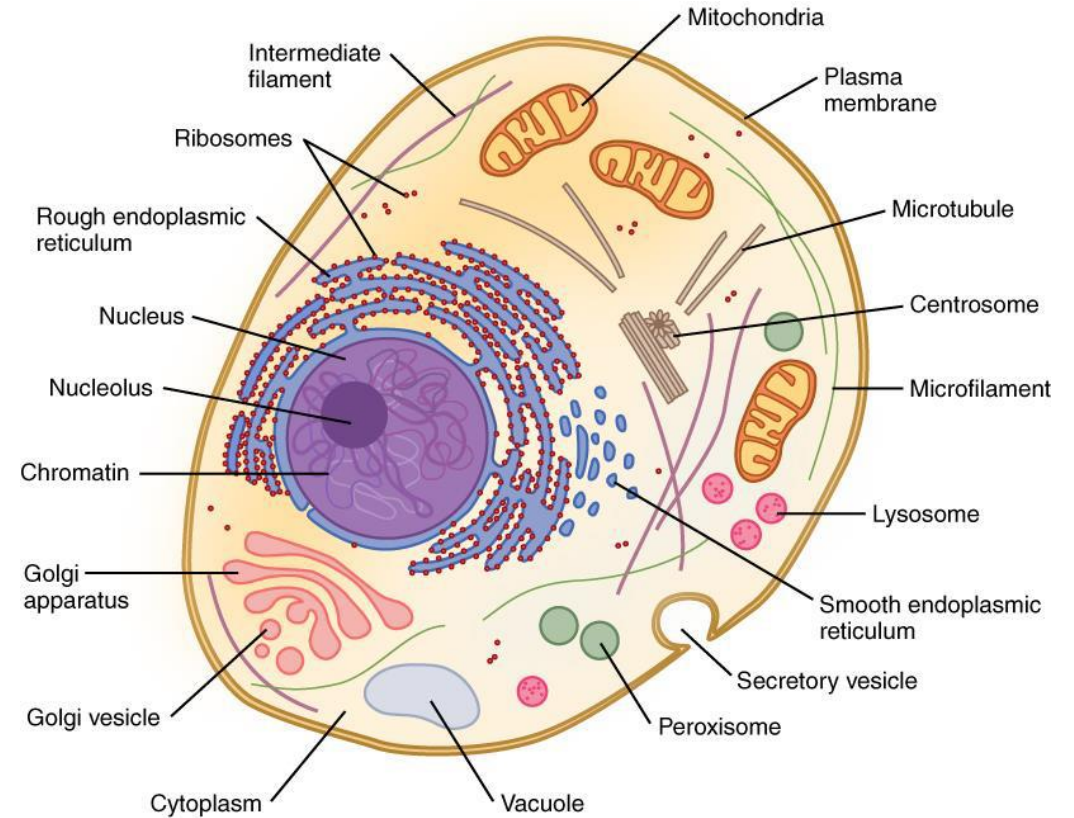
Cytoplasm is the base substance in which the organelles of the cell are suspended. It is a watery substance and allows for metabolic reactions to take place.

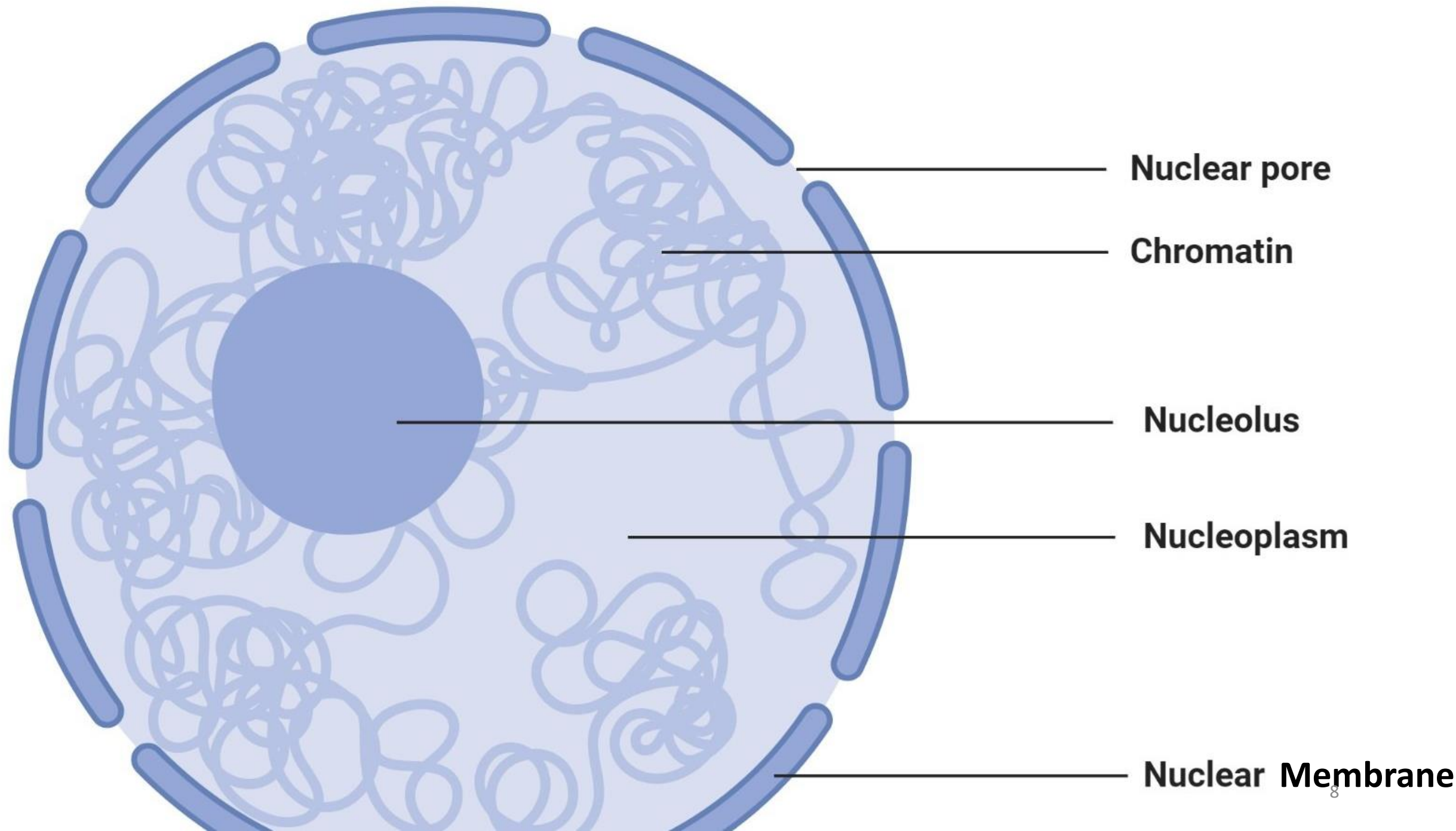
Ribosomes are small, round organelles which are mainly found attached to the endoplasmic reticulum or are free-floating in the cytoplasm.

Ribosomes can also be found inside other organelles such as the chloroplast and mitochondria but in smaller numbers.

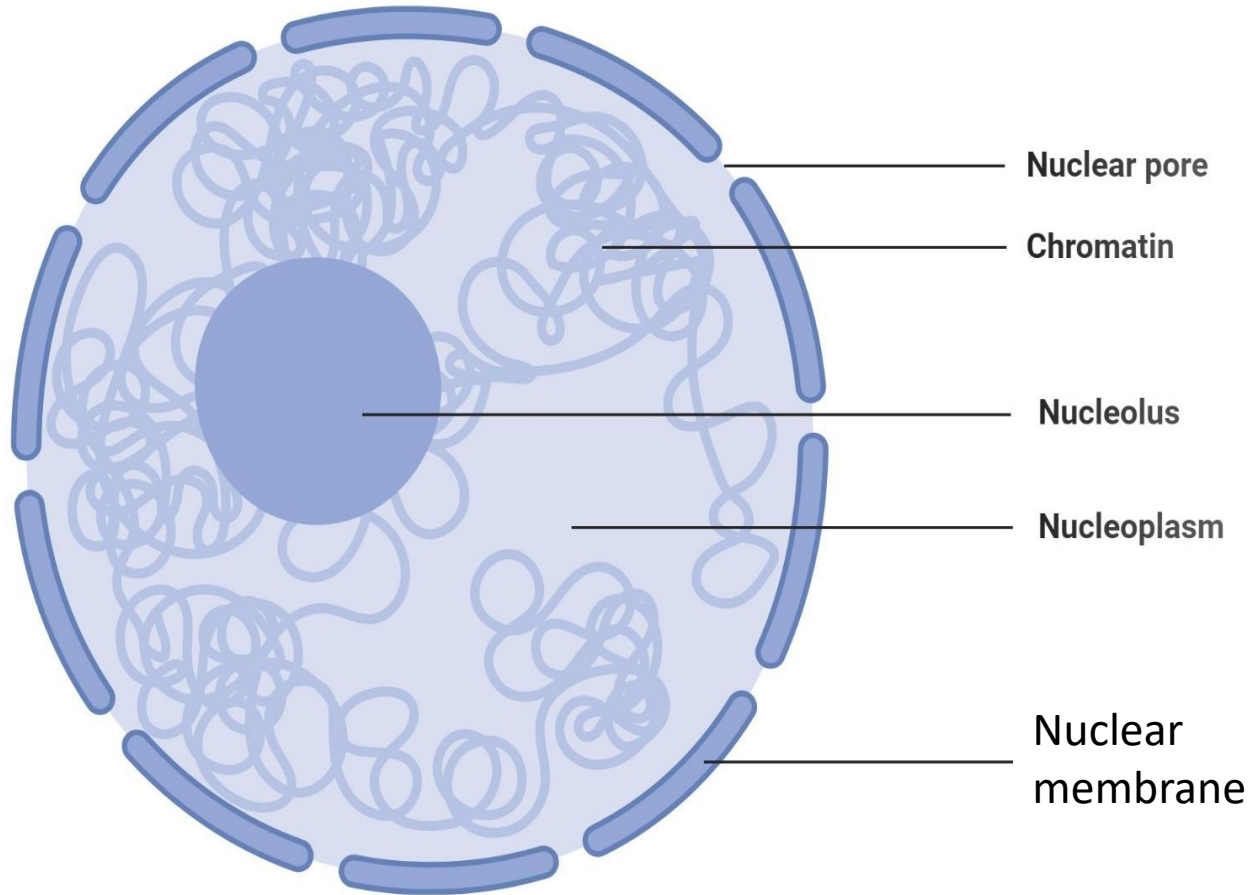
They are the **site of protein synthesis** and consist of RNA and protein.

The **nucleus** controls all of the cell's activities.





Nucleus



A nucleus has four main parts:

1 the **chromatin network** – found in the **nucleoplasm**: contains the DNA which forms the chromosomes containing the **genetic code** of a person / organism

2 the **nucleolus** – a dark body suspended in the **nucleoplasm** which contains free **nucleotide bases** and produces **ribosomes**

3 the **nucleoplasm** – this is a jelly-like fluid within the nucleus

4 the **double nuclear membrane** – it encloses the nucleus and contains small **pores** to allow for the passage of substances in and out of the nucleus

Question on the basic structure of the cell and nucleus

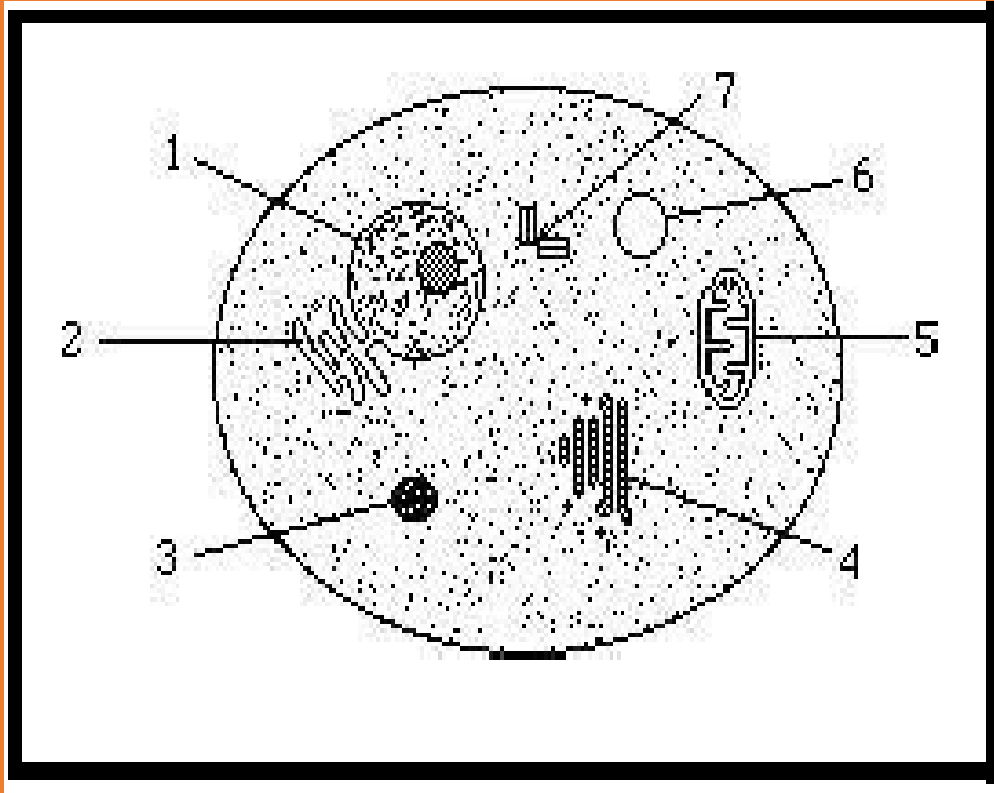


Diagram A

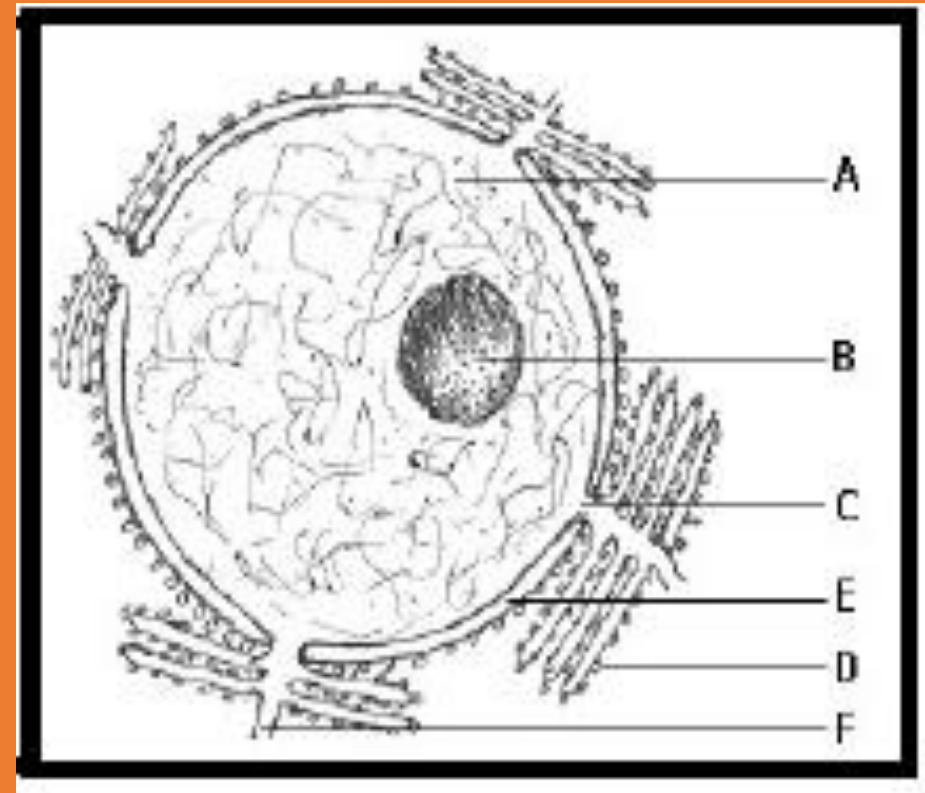


Diagram B

Question on
the basic
structure of
the cell and
nucleus

Diagram A

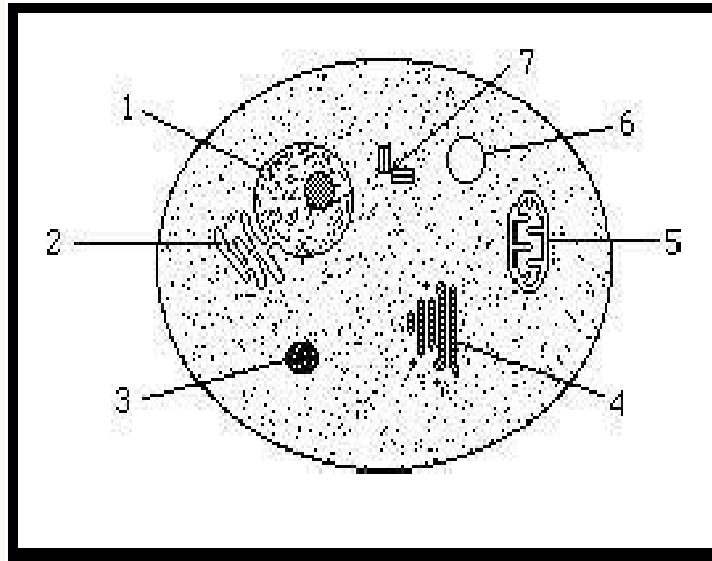
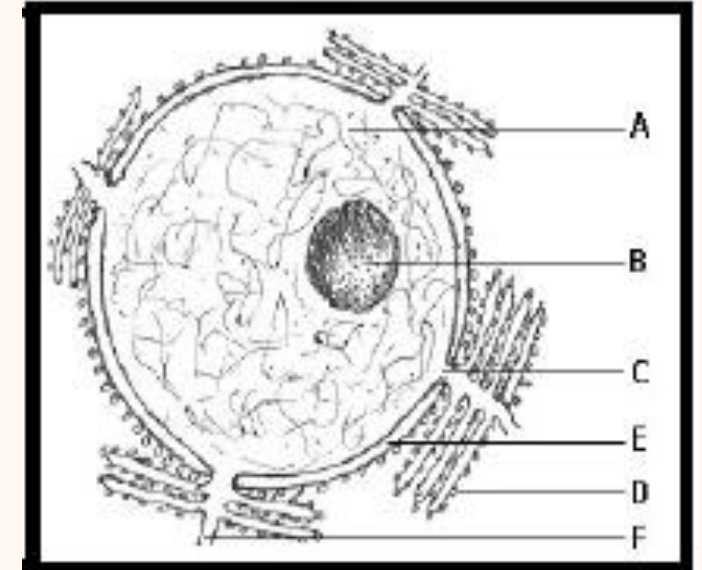


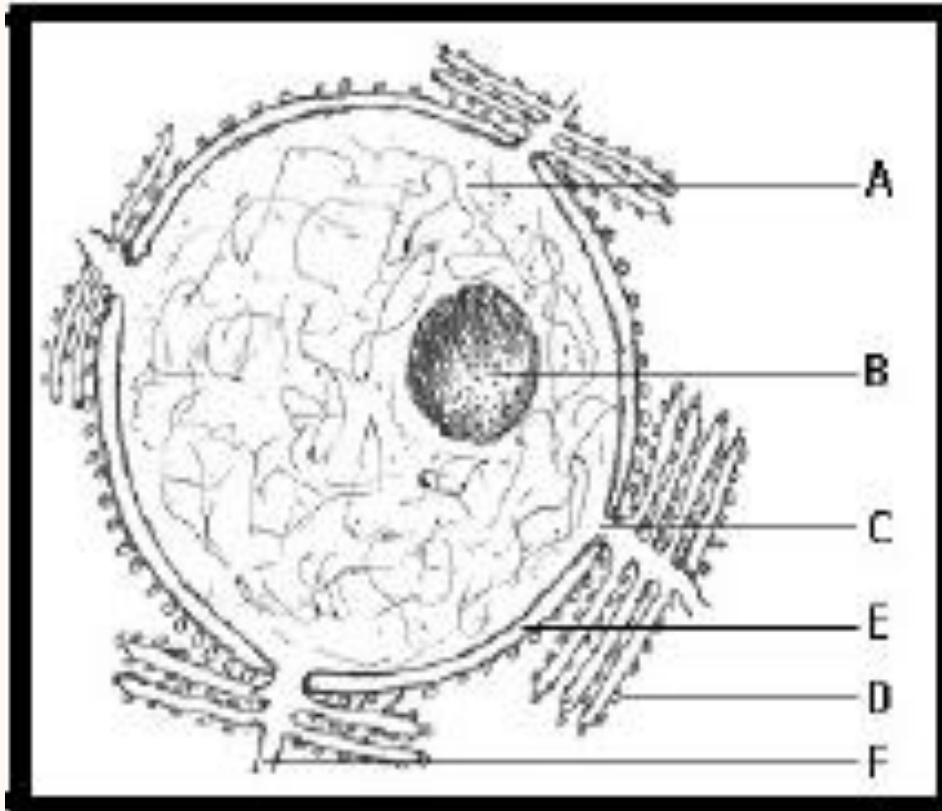
Diagram B



1 - Identify the organelle (number and name) in diagram A that is represented by diagram B

Question on the basic structure of the cell and nucleus

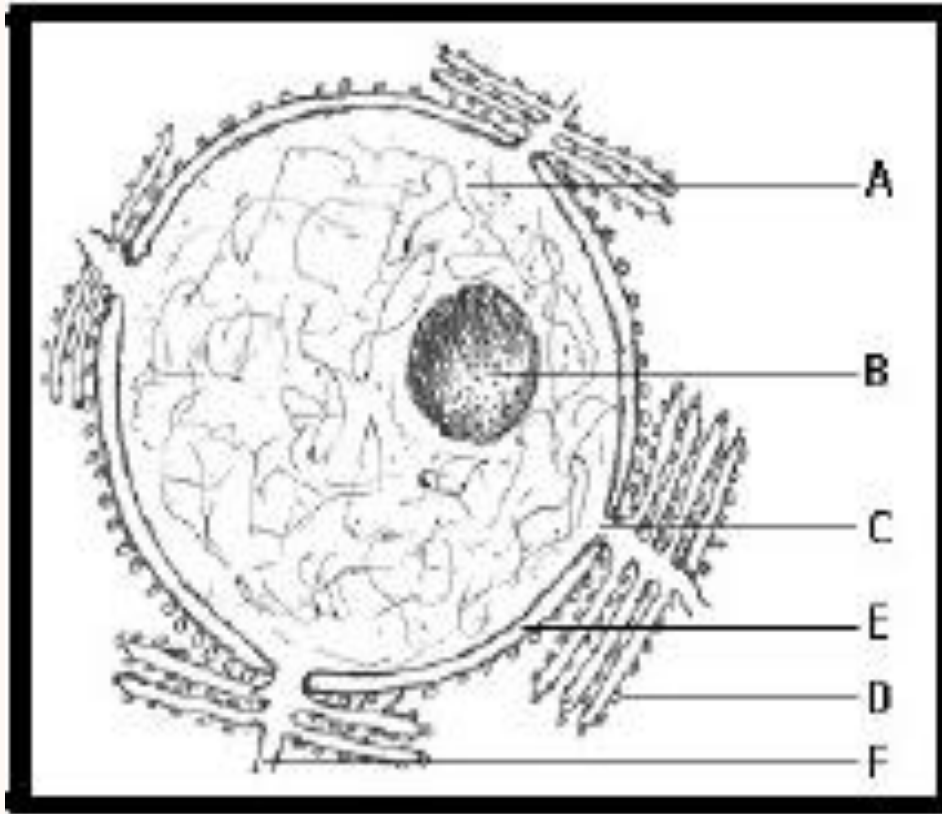
Diagram B



2 – Give the two nucleic acids present in diagram B

Question on the basic structure of the cell and nucleus

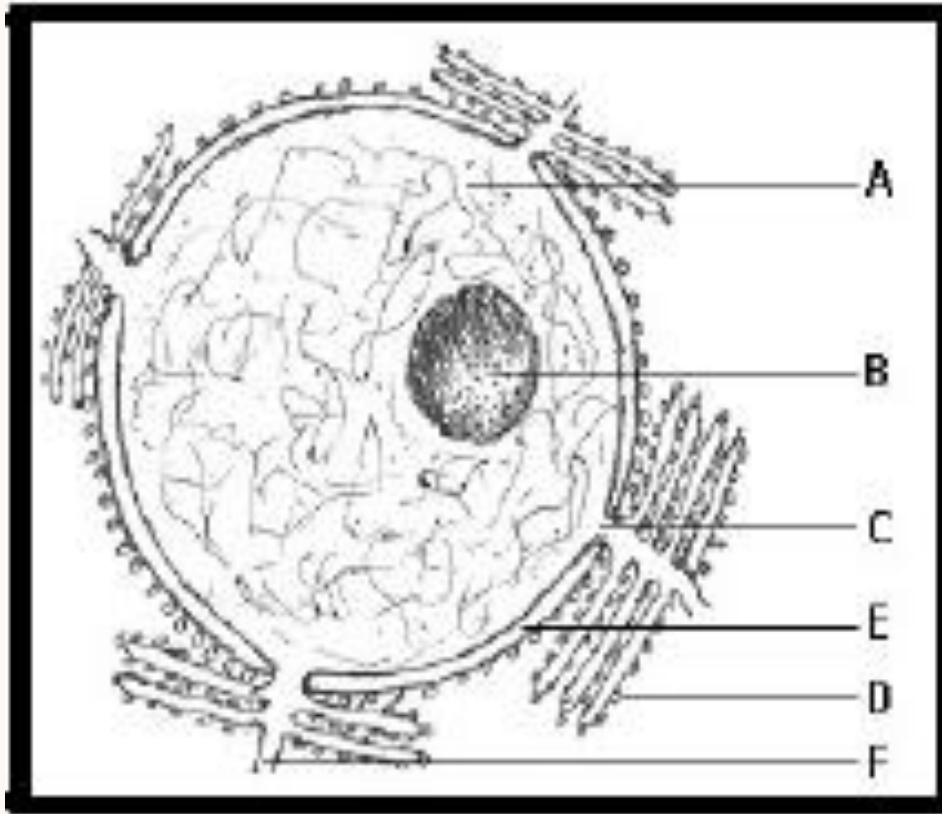
Diagram B



3 – Give the significance of the organelle represented in diagram B

Question on the basic structure of the cell and nucleus

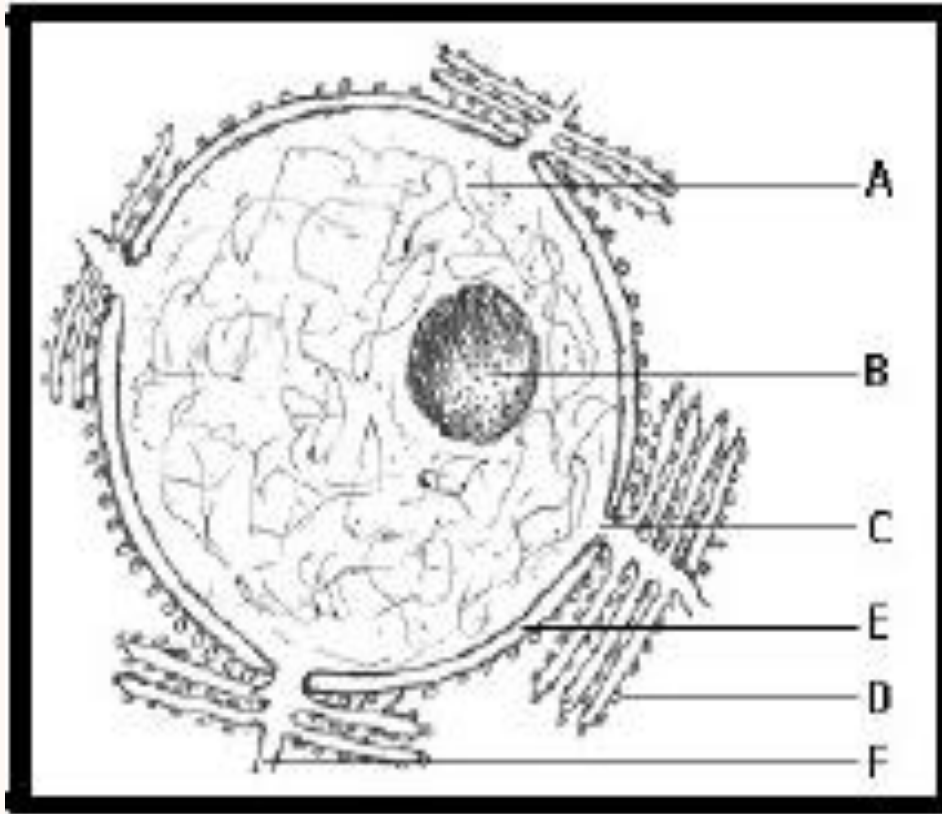
Diagram B



4 – Give the way that substances pass in and out of the organelle represented by B

Question on the basic structure of the cell and nucleus

Diagram B



5 – Identify label D

Answers:

.1 Identify the organelle (number and name) in Diagram A that is represented by Diagram B. 1✓ - nucleus✓

.2 Give the:

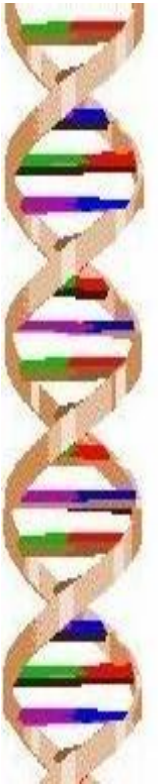
Two nucleic acids present in Diagram B.

- DNA✓ (Deoxyribonucleic acid)
- RNA ✓ (Ribonucleic acid)

3 Give the:

Significance of the organelle represented in Diagram B.

The nucleus controls all of the cell's activities.✓



Answers:

- 4 Give the: **Way in which substances get into and out of the organelle represented by diagram B**

The nuclear envelope has nuclear pores✓ that allow substances to enter and exit the nucleus.

- 5 **Identify label D. Ribosome✓**



Important Video's to watch

**DNA Structure and Replication: Crash Course Biology
#10 – Crash Course with Hank**

<https://www.youtube.com/watch?v=8kK2zwjRV0M>

**BBC Knowledge Explainer DNA | Experience | Territory
Studio**

<https://www.youtube.com/watch?v=YvQCBdTta-po>

Amoeba Sisters:

[DNA vs RNA \(Updated\) \(youtube.com\)](#)

[\(OLD VIDEO\) DNA Structure and Function \(youtube.com\)](#)



DNA: The Code of Life

NUCLEIC ACIDS (DNA AND RNA)

De oxy ribo

Nucleic

Acid

Location - Where is DNA?

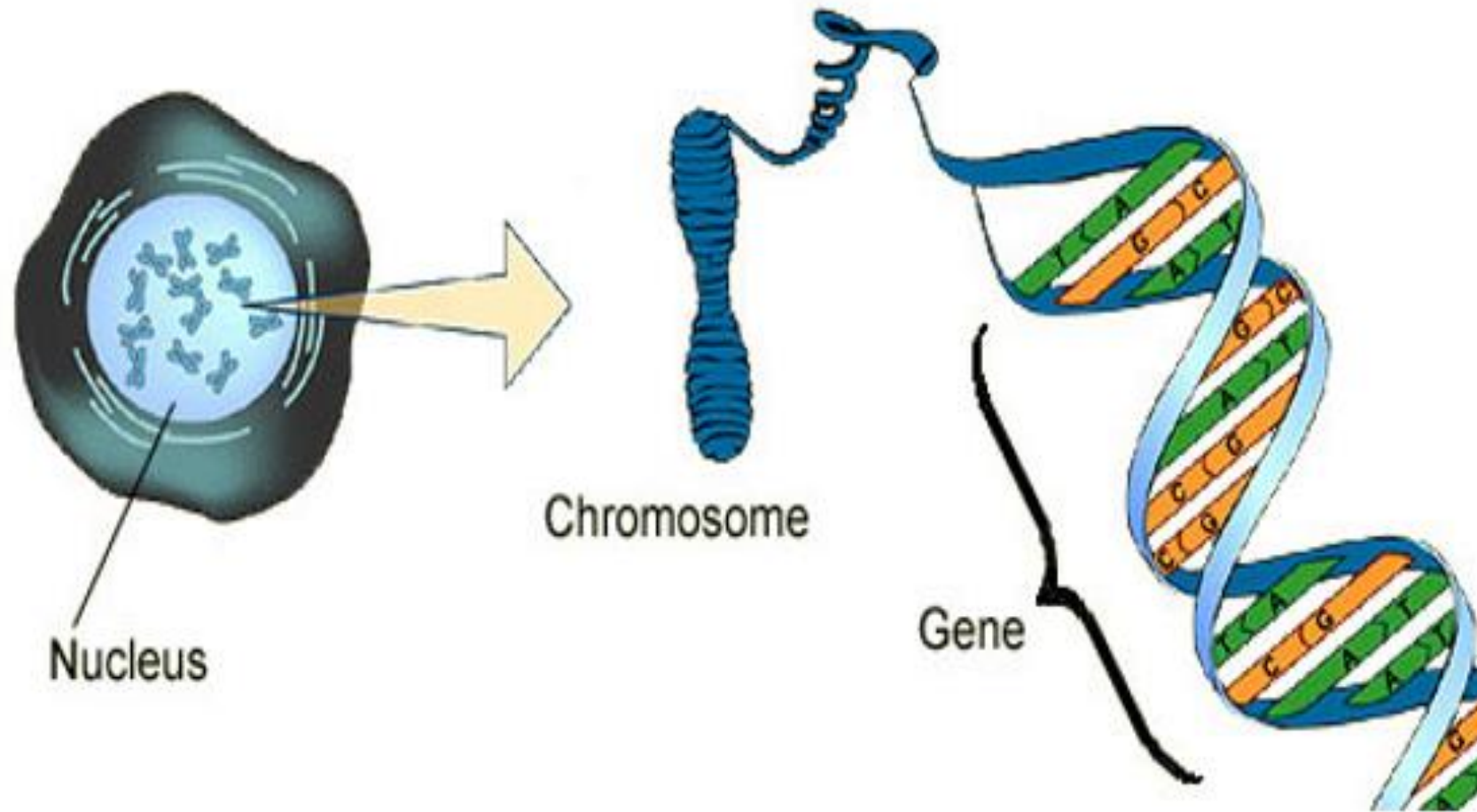
DNA is found in all animals and plants

- Nuclear DNA is found in the NUCLEUS
- Extracellular DNA is found 'outside' the nucleus, such as in the mitochondria. This is called mitochondrial DNA (mt DNA) and in the chloroplasts - this is called chloroplastic DNA



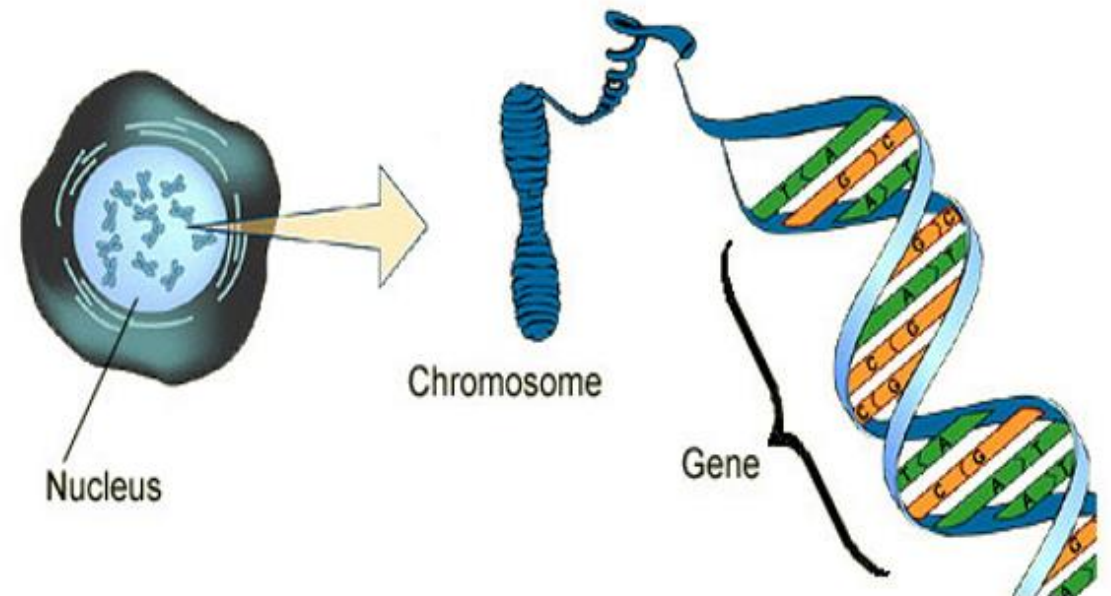
GENES, DNA AND CHROMOSOMES

A short piece of DNA is called a **GENE**



The FUNCTIONS of DNA

- Sections of DNA forming genes carry hereditary information
- DNA contains coded information for protein synthesis



Who Discovered DNA?

DNA was discovered by:

- 1952 – Rosalind Franklin and her assistant Maurice Wilkins researched the structure of DNA using X-ray diffraction images.
- Watson and Crick did independent research on DNA. Upon seeing Franklin's images, they proposed a 3-D double helix model for DNA in 1953.
- 1962 – Watson and Crick received the Nobel Prize for the discovery of the structure of DNA, and Wilkins received an award for his X-ray photography. Franklin had died of cancer.

Rosalind Franklin – background: <https://www.youtube.com/watch?v=BIP0lYrdirl>

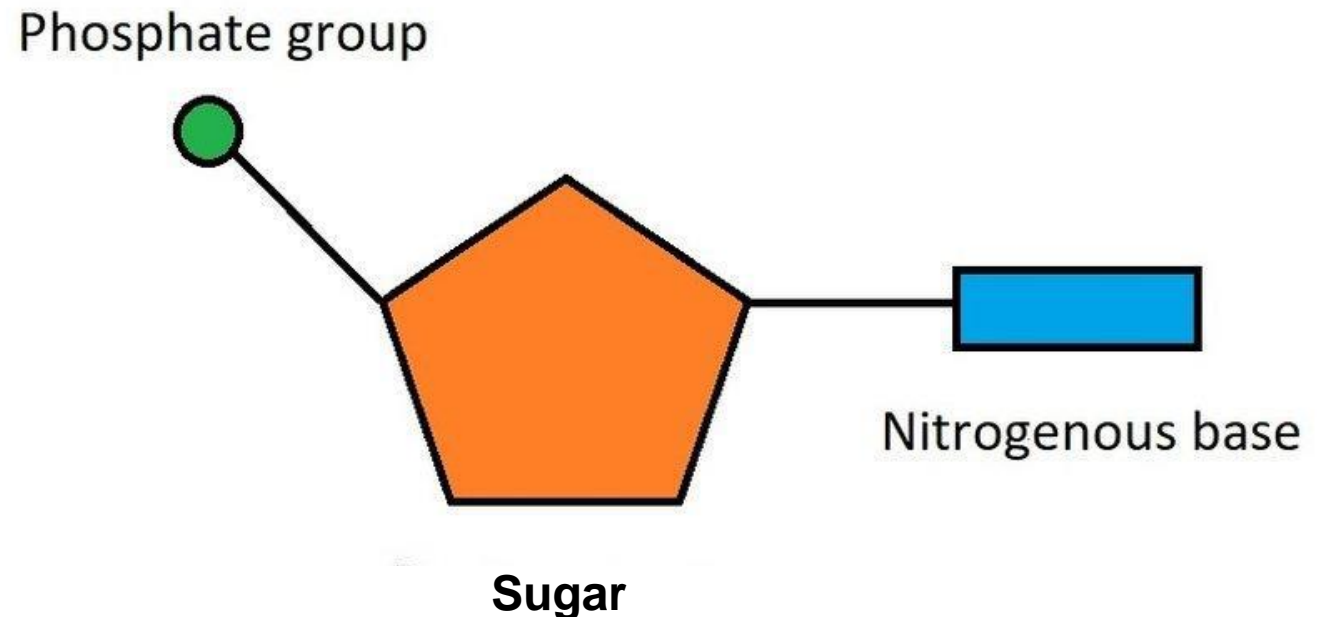
What is DNA made of? (What is its structure?)

DNA is made of **NUCLEOTIDES**

Nucleotides are the building blocks of NUCLEIC ACIDS (DNA and RNA)

A nucleotide consists of **THREE** parts:

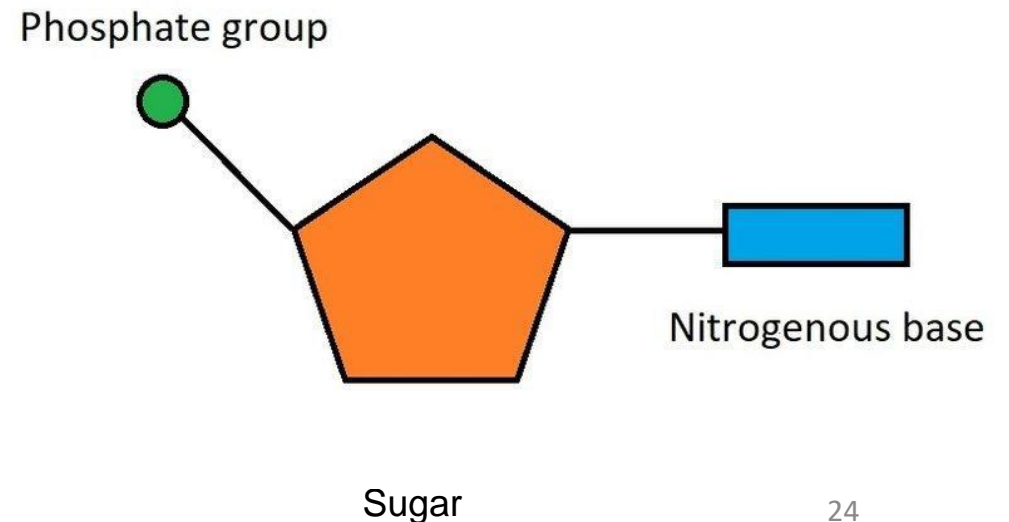
- A PHOSPHATE group (PO_4)
- A SUGAR
- A NITROGENOUS BASE



The Structure of DNA

DNA is made up of NUCLEOTIDES which consists of 3 parts:

- Phosphate group: (PO₄)
 - Sugar (a ribose sugar called deoxyribose)
 - Nitrogenous Base
-
- The phosphate group forms the backbone of the DNA molecule
 - There is a sugar-phosphate bond holding the phosphate and sugar together
 - Think of the chocolate **PS** to remember the order of the **P**hosphate and **S**ugar. The nitrogenous base is only connected to the sugar (not the phosphate).



Nitrogenous Bases

- Adenine
- Thymine
- Cytosine
- Guanine

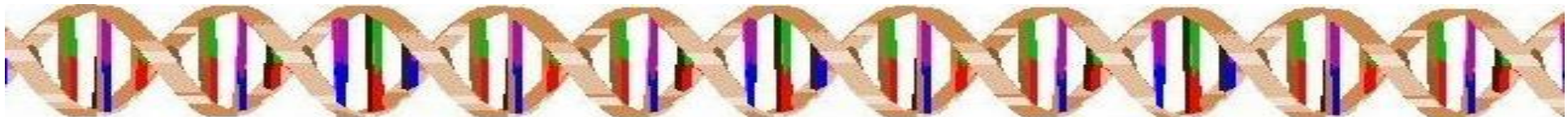
Adenine and Thymine are complimentary base pairs joined by **TWO** weak Hydrogen bonds

Cytosine and Guanine are complimentary base pairs joined by **THREE** weak Hydrogen bonds

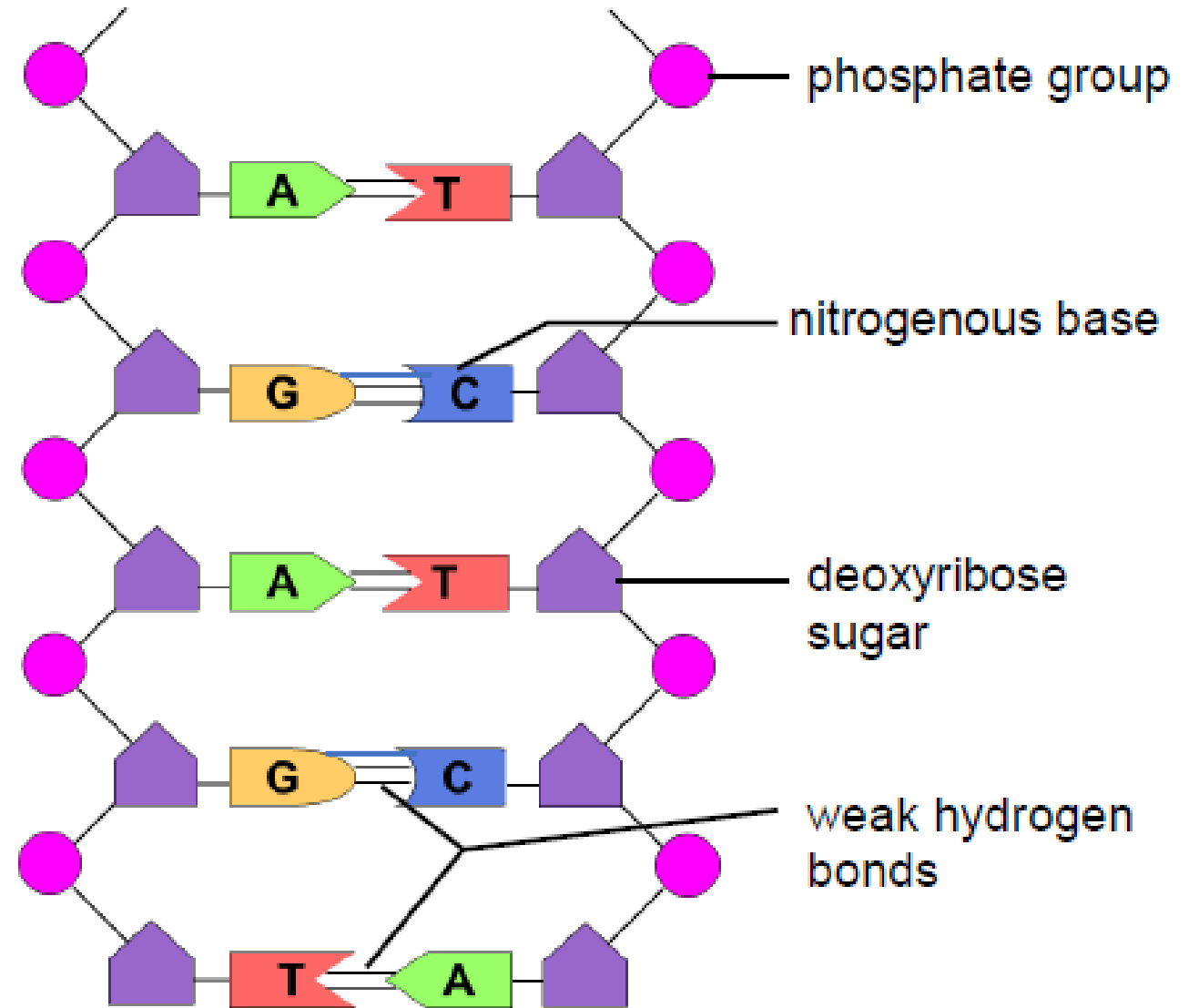
Remember

Apple on the **T**ree

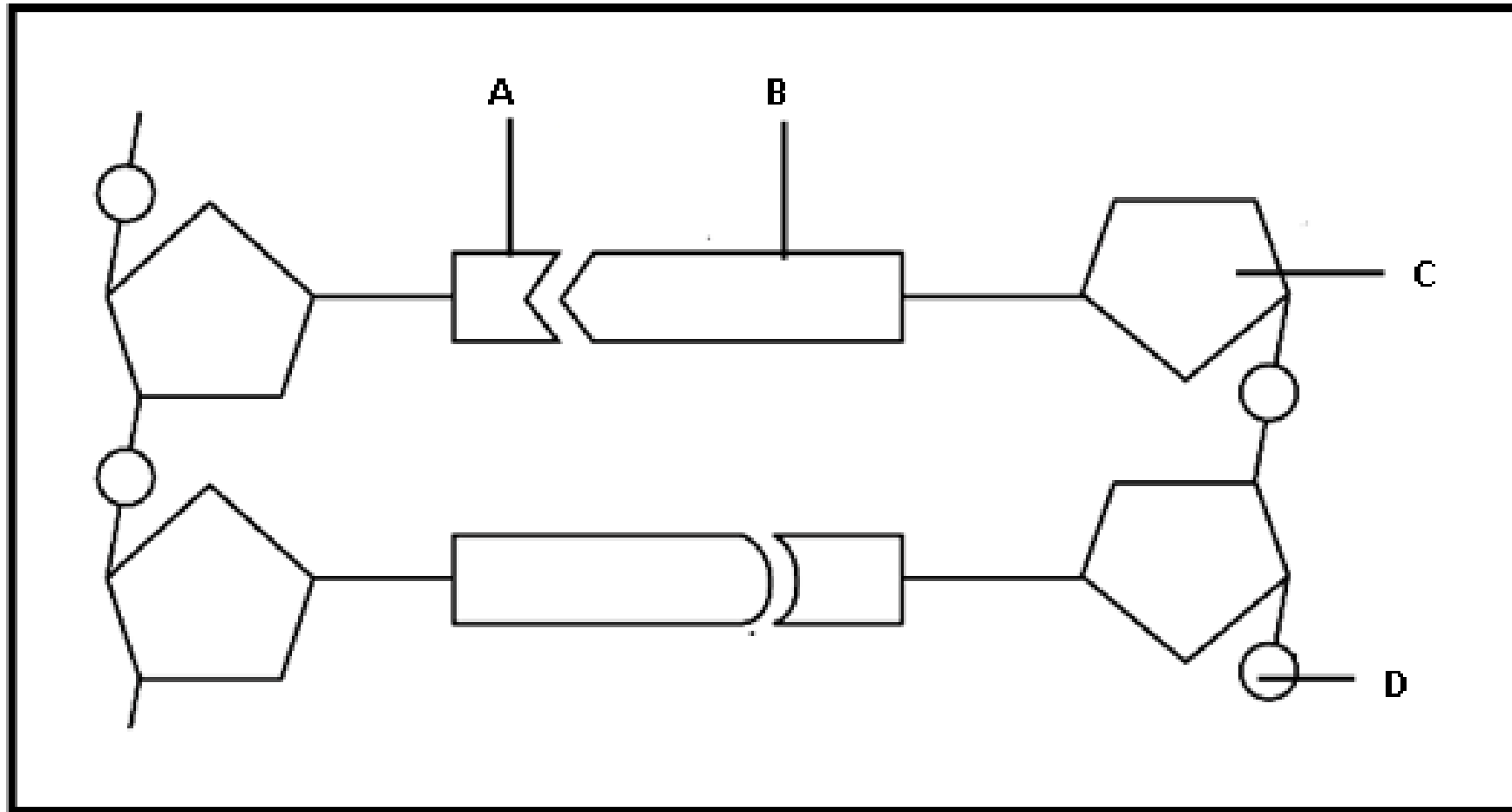
Car is in the **G**arage



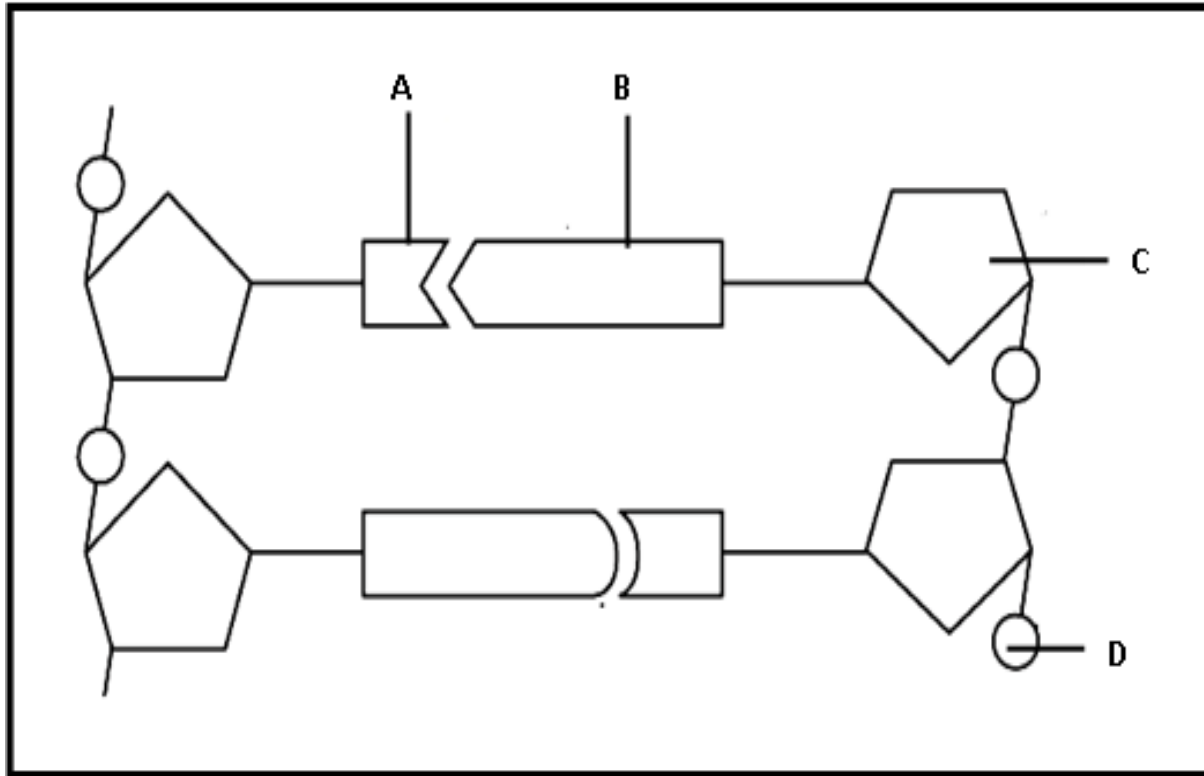
How to recognise a DNA molecule in an exam



The diagram below shows a short section of a DNA molecule



The diagram below shows a short section of a DNA molecule

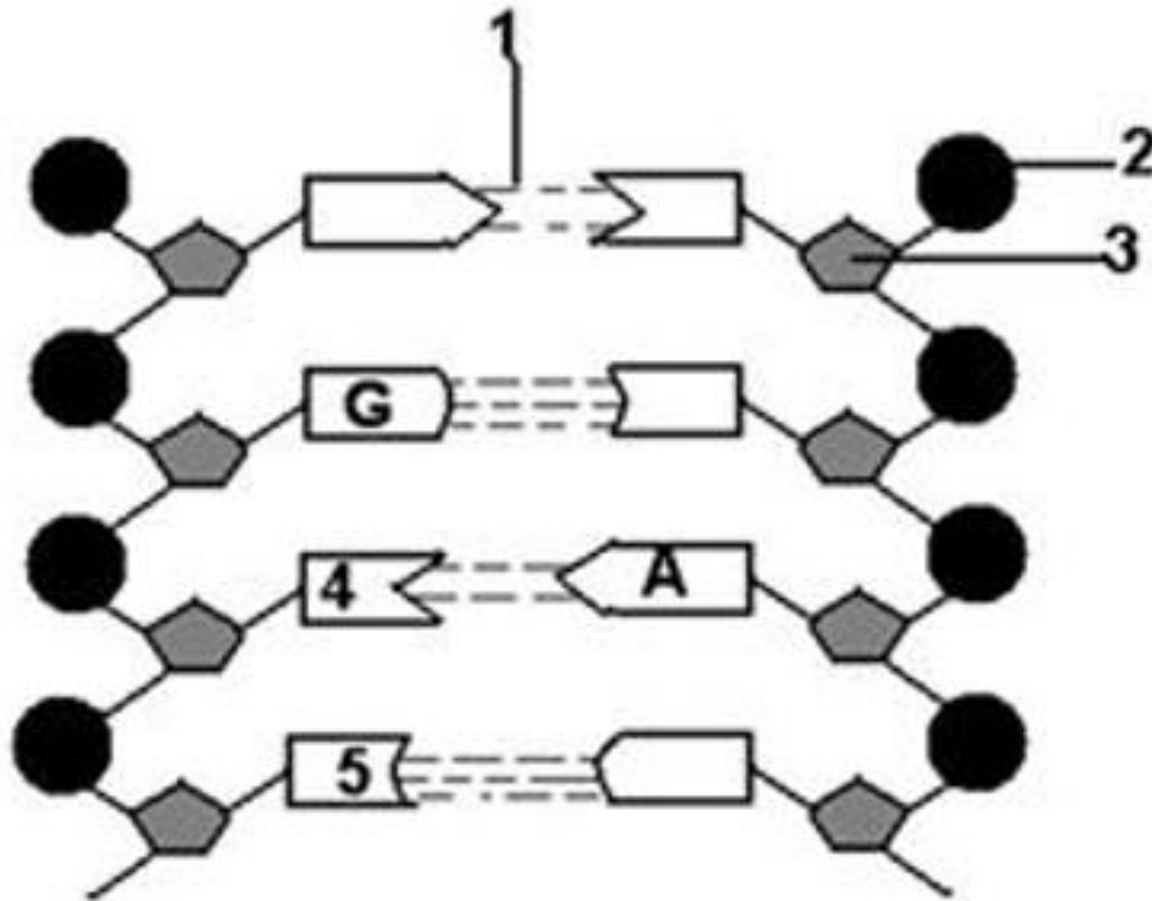


1 - Identify part **C** and part **D** respectively

2 - Name the type of bond that joins **A** and **B**.

3 - Give **ONE** visible reason for identifying the above molecule as DNA.

1 C = deoxyribose sugar
D = phosphate group/ion

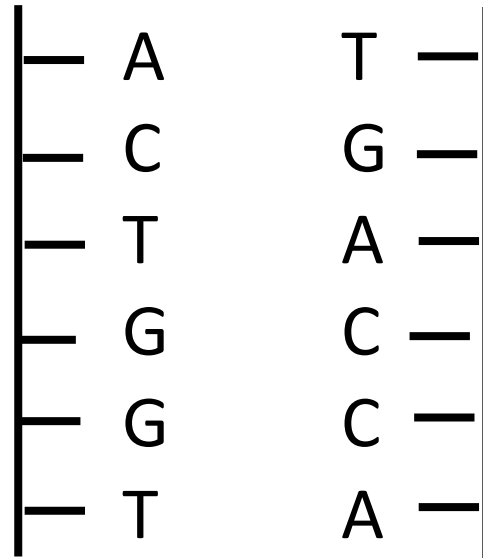


KEY:
A - Adenine
G - Guanine

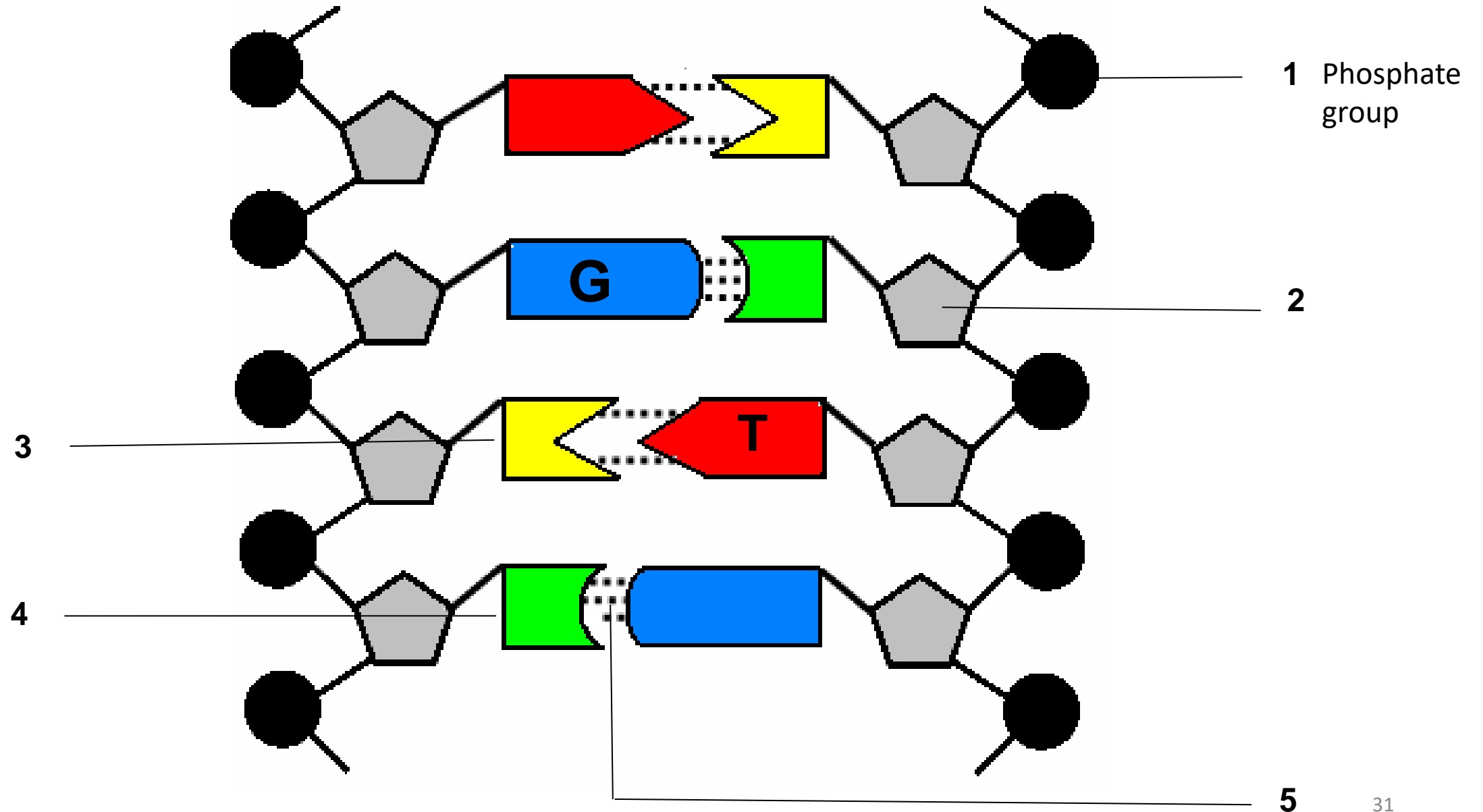
Questions

- 1 Name this molecule?
- 2 What is at 1?
- 3 What is the **collective name** for 4, 3, 2?
- 4 What is A?

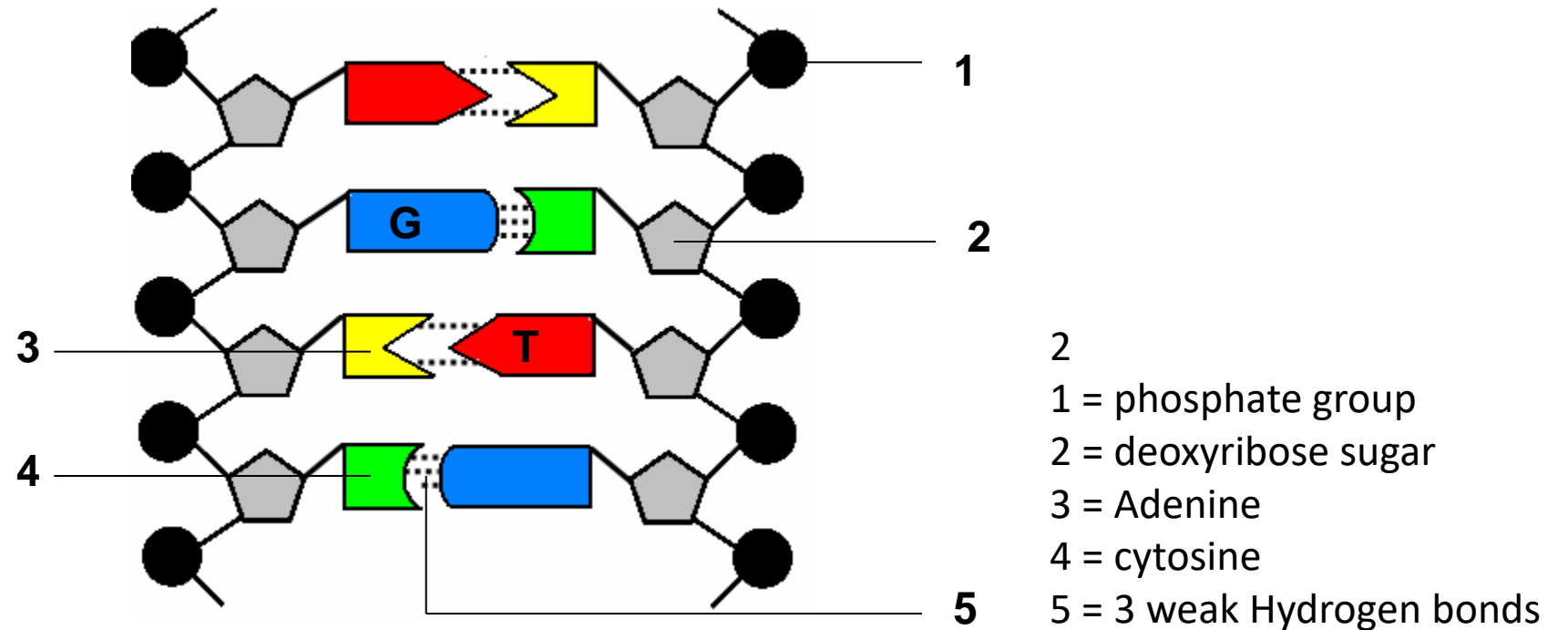
Exam Tip: Sometimes in an exam,
they ask you to draw a **STICK**
diagram of DNA



Questions on the DNA Molecule



Questions



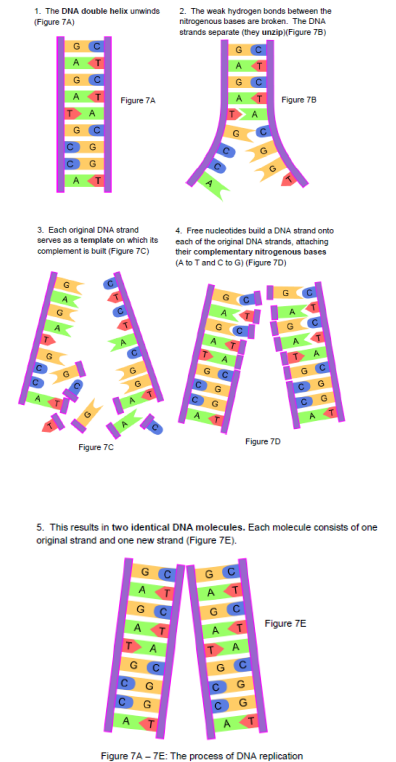
1. Identify the above molecule.
2. Give labels for parts numbered 1 to 5
3. Describe how the above molecule replicates itself. Makes copies of itself
4. Why is it of significance that this molecule can replicate itself?

Answer to No. 3

How DNA replication takes place

- The double helix unwinds.
- Weak hydrogen bonds between nitrogenous bases break and two DNA strands unzip
- Each original DNA strand serves as a template on which its complement is built.
- Free nucleotides build a DNA strand onto each of the original two DNA strands by attaching to their complementary nitrogenous bases (A to T and C to G).
- This results in two identical DNA molecules.
- Each molecule consists of one original strand and one new strand

See page 15 in the textbook for a cool diagram



1. The DNA double helix unwinds (Figure 7A)

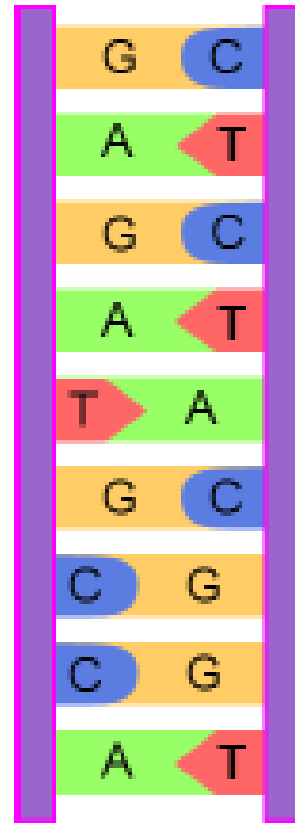


Figure 7A

2. The weak hydrogen bonds between the nitrogenous bases are broken. The DNA strands separate (they unzip)(Figure 7B)

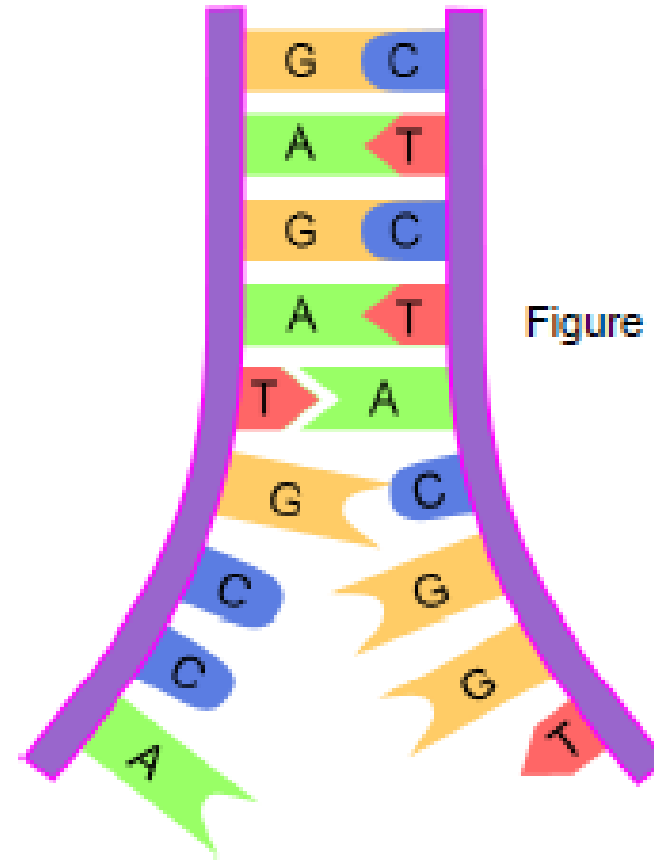


Figure 7B

3. Each original DNA strand serves as a template on which its complement is built (Figure 7C)

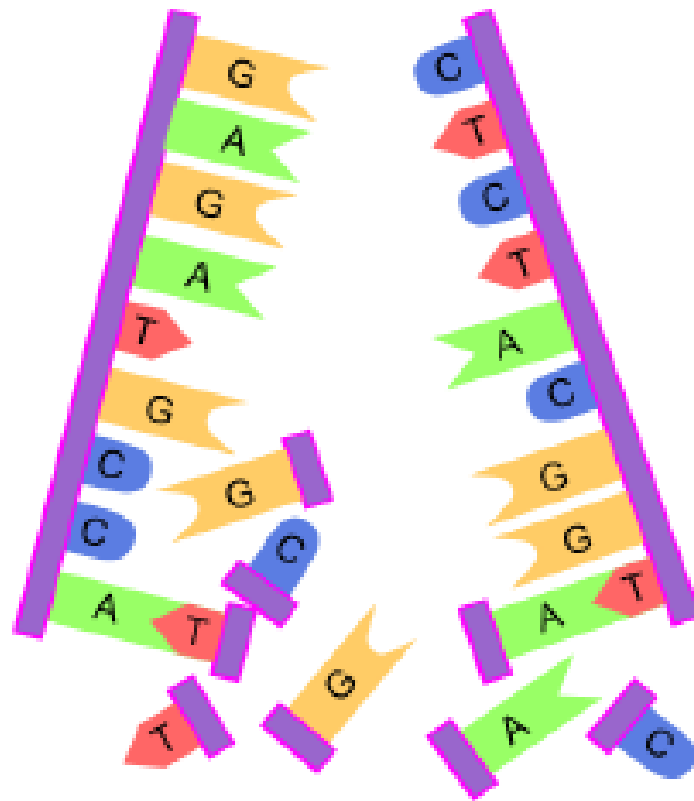


Figure 7C

4. Free nucleotides build a DNA strand onto each of the original DNA strands, attaching their complementary nitrogenous bases (A to T and C to G) (Figure 7D)

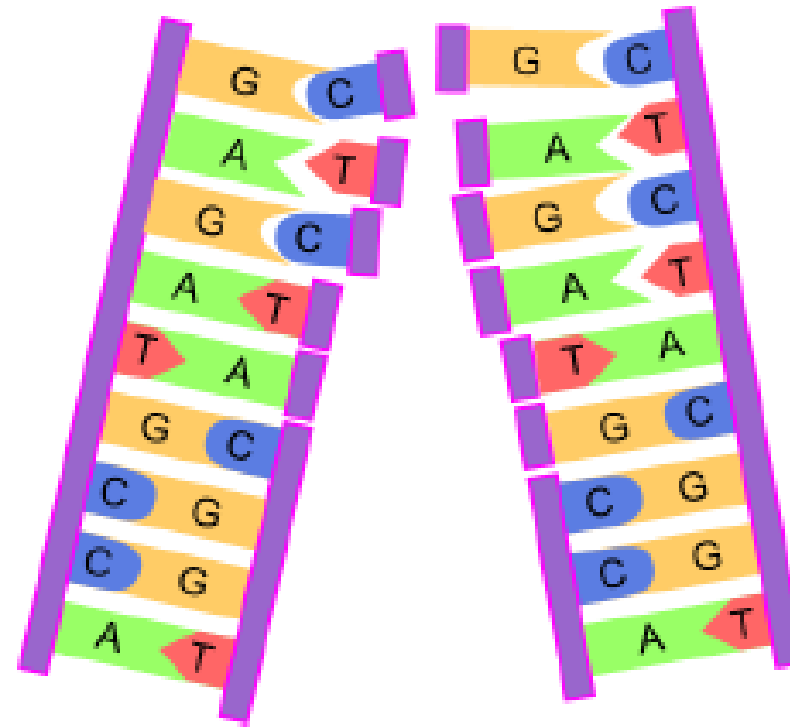


Figure 7D

5. This results in two identical DNA molecules. Each molecule consists of one original strand and one new strand (Figure 7E).

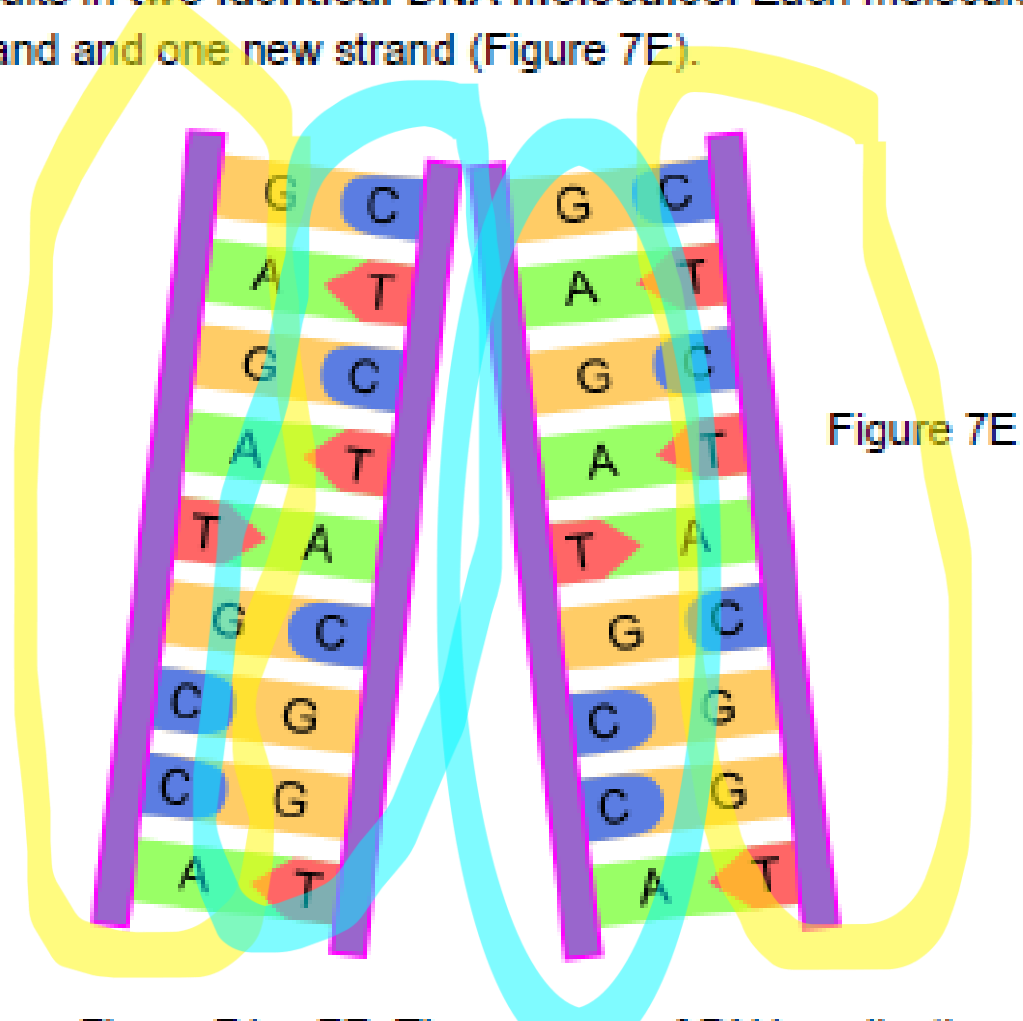


Figure 7A – 7E: The process of DNA replication

Why is it of significance that the DNA molecule can replicate itself?

Answer to No. 4 - it is of significance that this molecule can replicate itself

because it allows each chromosome to be copied so that each new identical daughter cell produced contains the same number and type of chromosomes

The significance of DNA replication:

- DNA replication is important because it:
- Doubles the genetic material so it can be shared between the resulting daughter cells during cell division.
- Results in the formation of identical daughter cells during mitosis.

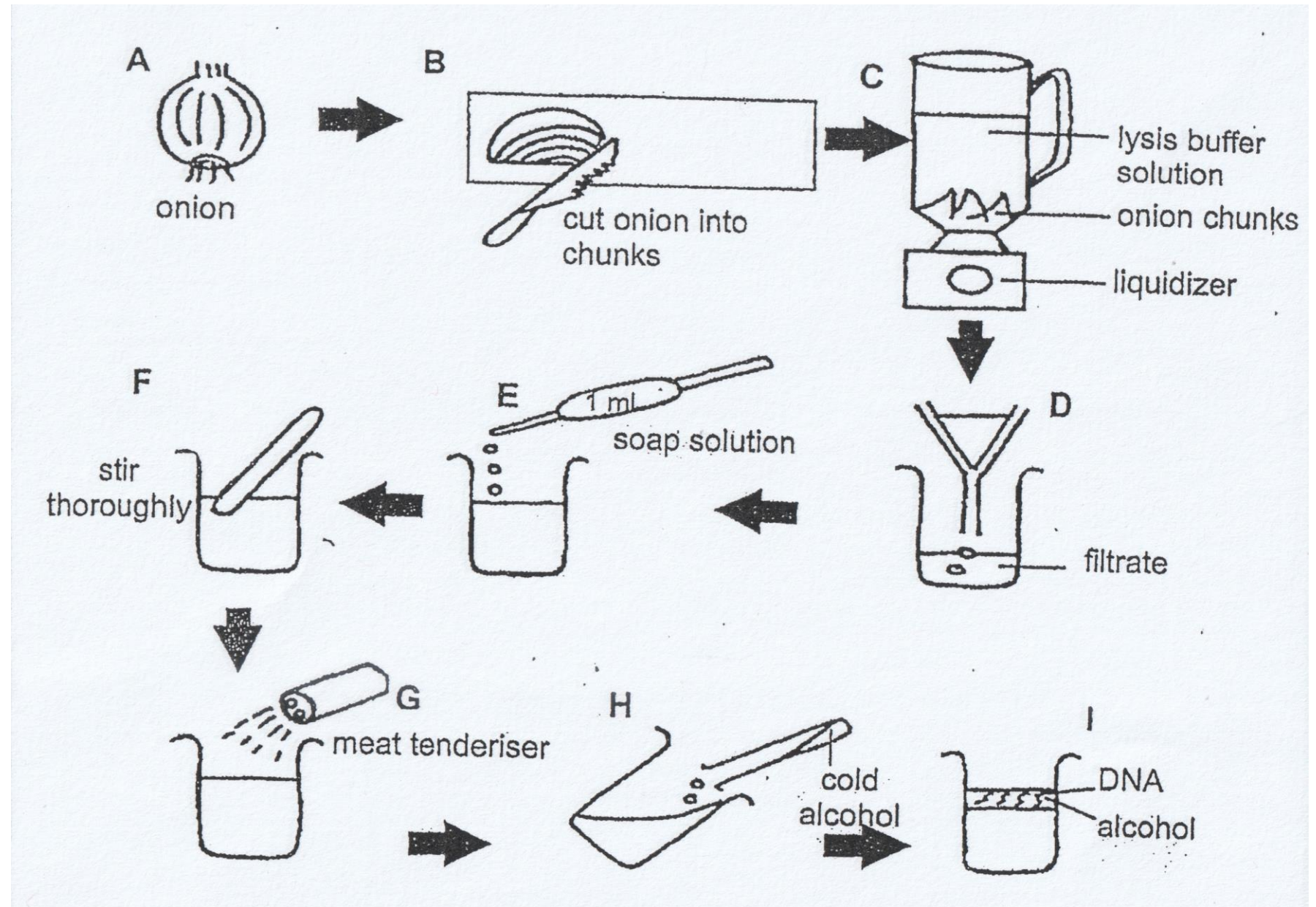


Experiment to isolate (or extract) DNA



The function of the **soap solution** is to break up the cell membrane to release the DNA

The function of the **alcohol** (or methylated spirits) is to separate the DNA



DNA Extraction - What is the FUNCTION (the job) of the substances:

The FUNCTION of the hot water is that the high temperature causes destruction of the 3D structure of the proteins, which then separates them from the DNA.

The FUNCTION of Salt (NaCl) is to crystallise the DNA
(DNA is not visible - the salt combines with the DNA to form tiny crystals that we will be able to see).

The FUNCTION of the Washing Up Liquid is to break down the cell membranes releasing the DNA in the cell nuclei. The cell membrane is basically fat and the washing up liquid breaks that down.

The FUNCTION of the Meat Tenderiser (enzymes) is to unwrap the DNA from its histone proteins with which it is tightly wrapped.

The FUNCTION the Alcohol/Methylated Spirits is to cause the DNA to settle out of solution- DNA is soluble in water but not in alcohol, so it precipitates out in the white clumps that makes you who you are !!!



Ross @freeminds.co.za