

# Understanding Cancer

**A SERIES OF SIMPLE EDUCATIONAL VIDEOS  
FOR THE GENERAL PUBLIC**



*By Dr Hafsa Waseela Abbas*

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# Understanding Cancer

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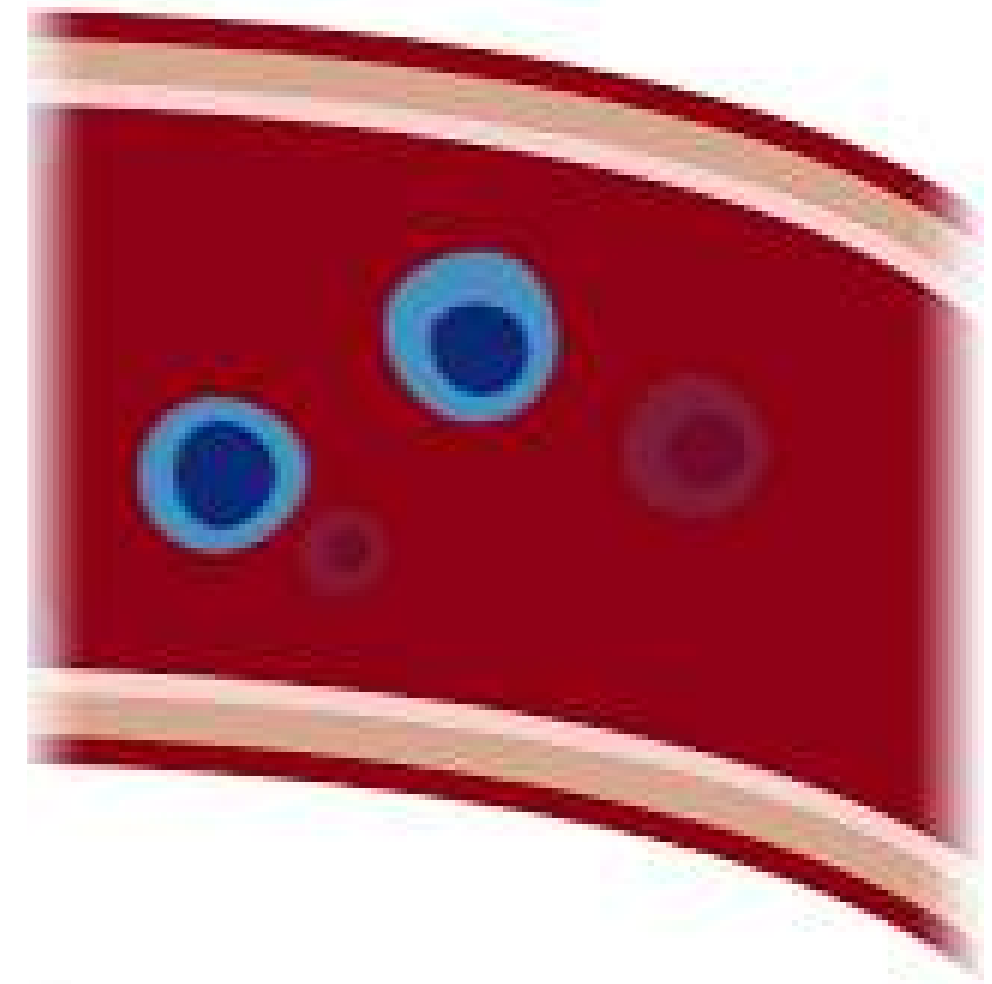
*Part 8: Diagnosis - Blood test*

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# The blood

Our blood contains many substances that help provide energy, support, protection and ensure our body is working well.

70% of our body is made of water.



# Red blood cells

They carry oxygen to allow us to breathe.

They are red because of a protein called:

**HAEMOGLOBIN**

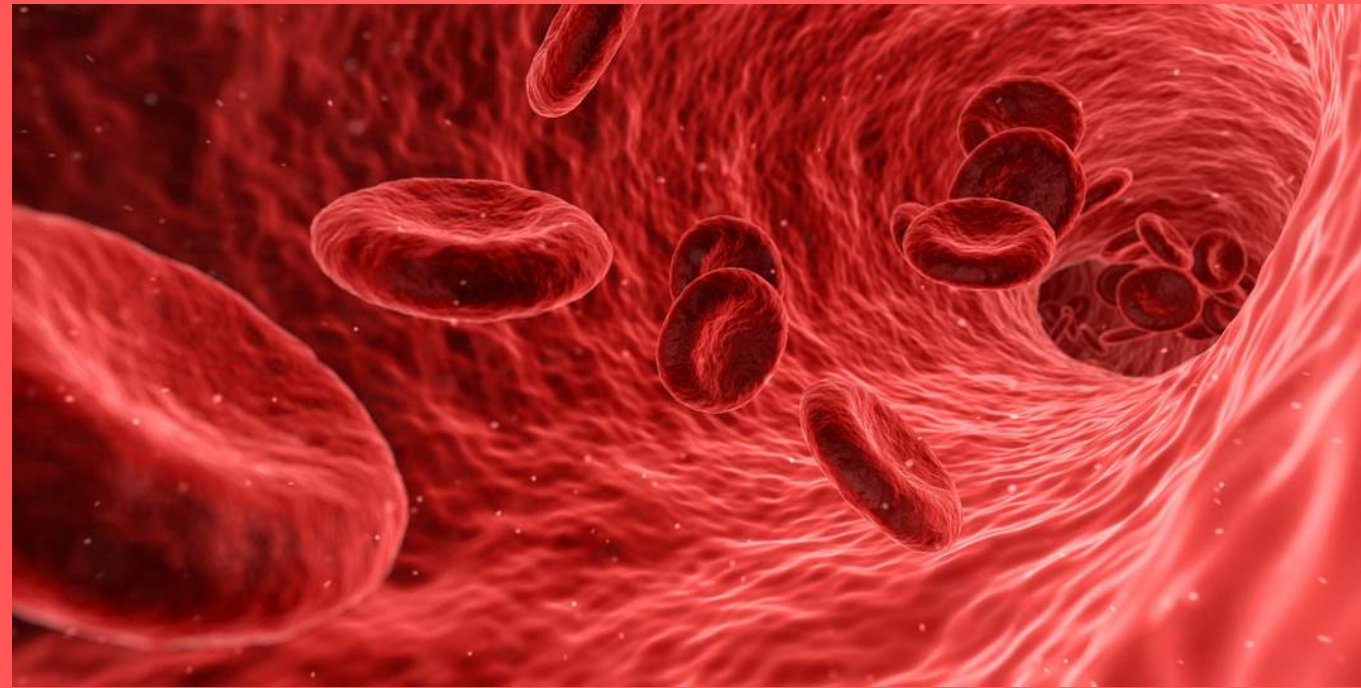
**Iron**

**Protein**





# Red blood cells



The oxygen binds to the haemoglobin to form  
OXYHAEMOGLOBIN.

**When there is low levels of iron, haemoglobin or  
vitamin B12 it can cause ANAEMIA.**

# White blood cells

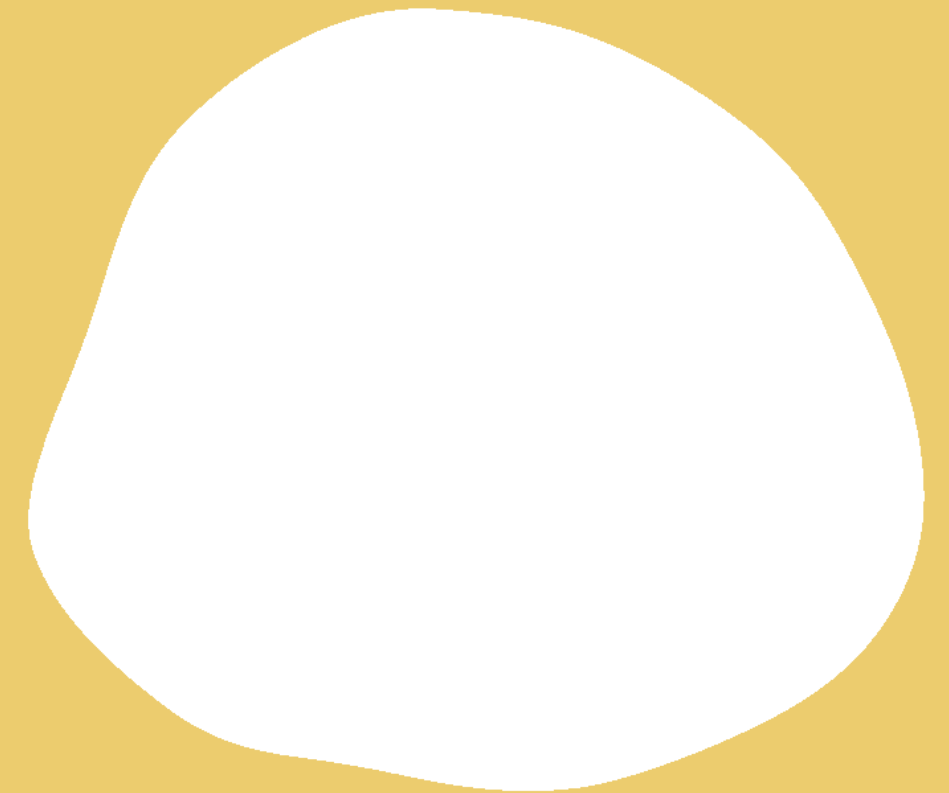
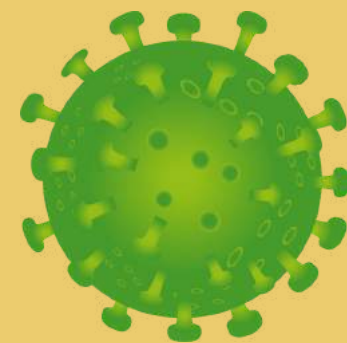
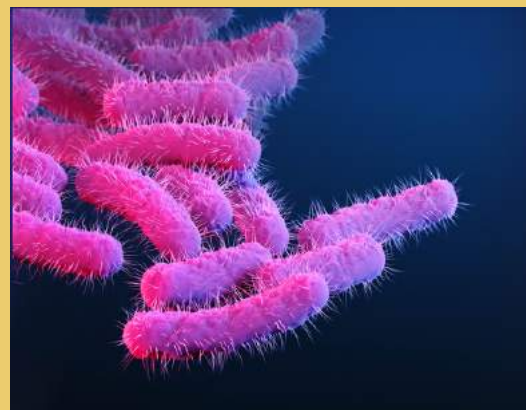
They protect the body from infection caused by:

**MICROORGANISM**

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Very small

Bacteria. Virus. Fungi



# **How do white blood cells remove pathogens?**

**Pathogens are microorganisms that cause disease.**

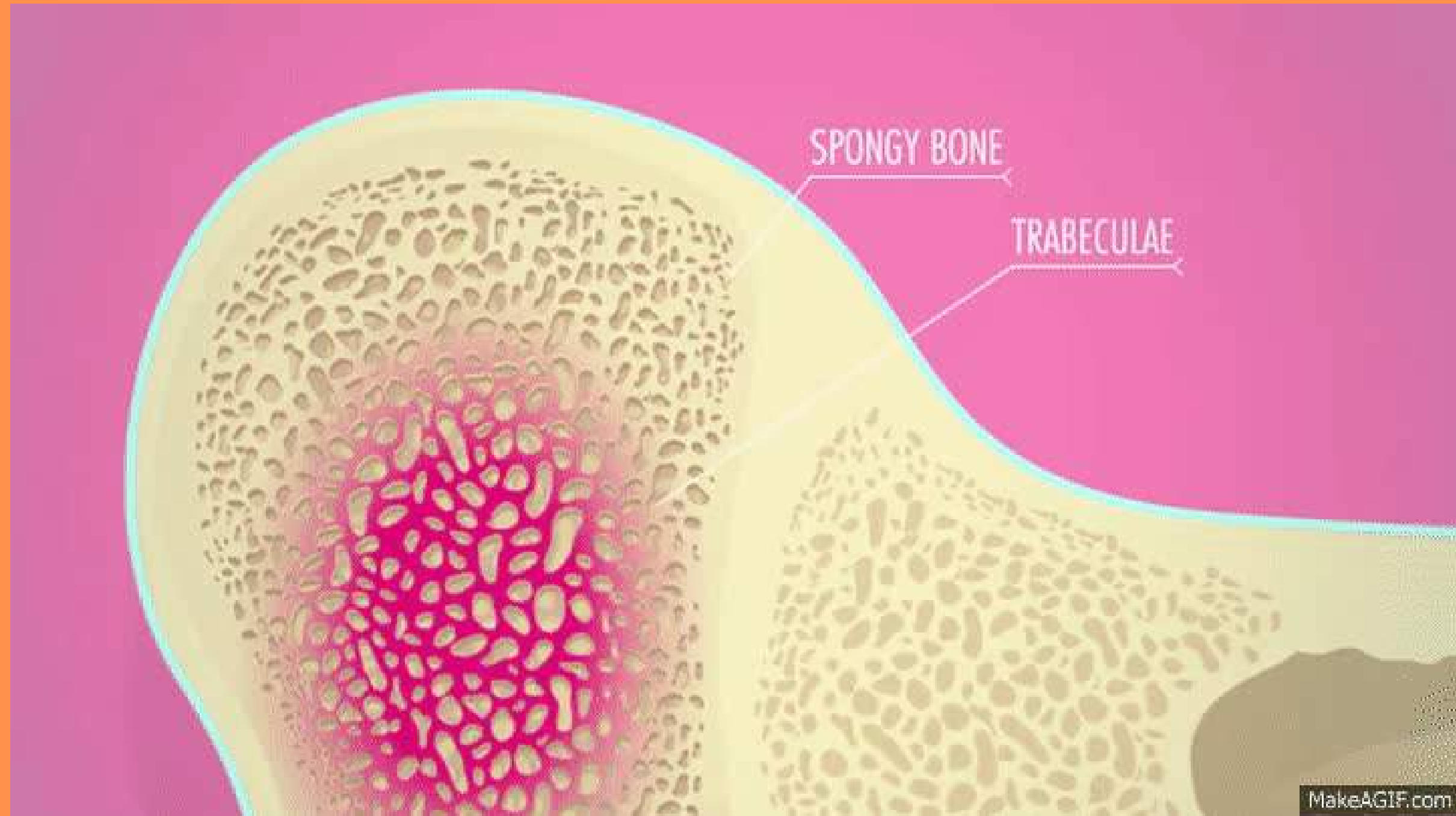
- Engulf/eat pathogens and break them down.
- They produce proteins called antibodies that recognise and bind to specific pathogens and turn them off and kill them.

# Platelets

- They are colourless small fragments.
- They clot the blood to stop the loss of blood when there is a cut/injury.
- Clotting is the joining or clumping of substances.







**The red blood cells, white blood cells and platelets are produced in the bone marrow. A sponge-like tissue in the bones.**

***The plasma is a liquid found in the blood.***

***Hormones: Chemicals that regulate body functions.***

***Nutrients:***

***Glucose needed for energy.***

***Amino acids to make protein for growth and repair.***

***Fatty acids to make fat molecules.***

***immune cells and proteins for defence.***

**Other  
substances  
found in the  
blood**



# What is a blood test?

Blood is taken from the vein in the arm for analysis/ investigation at the laboratory.

This will help find out what is wrong with the patient.

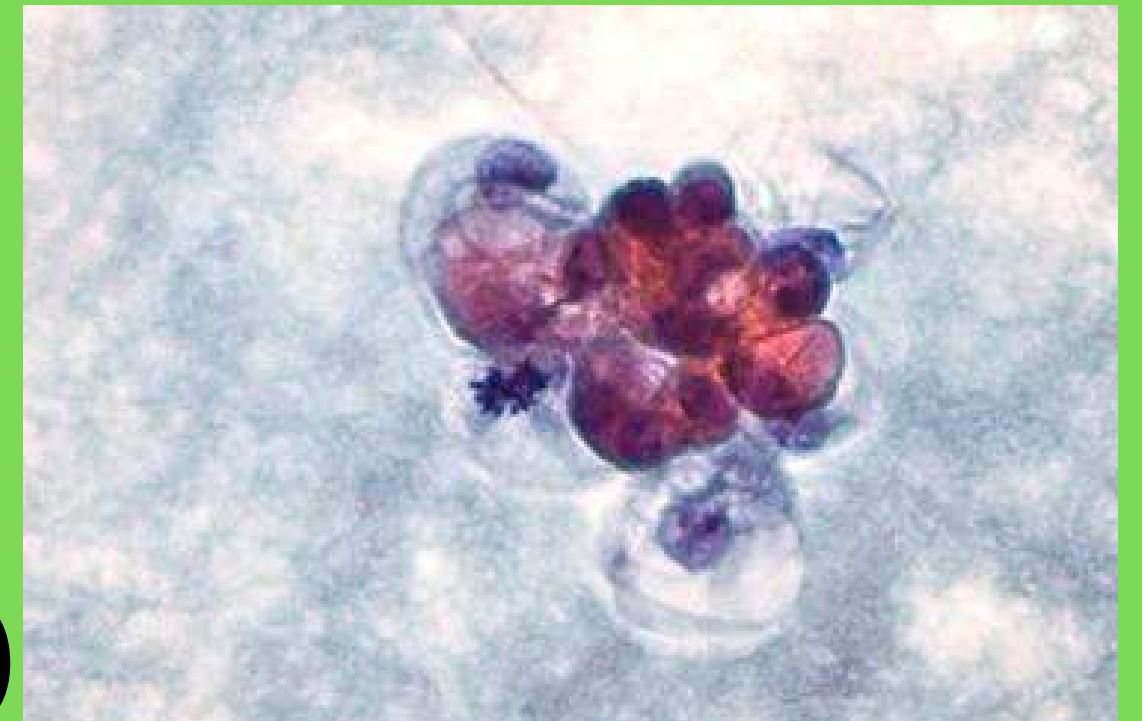




# Common investigations

The following are common tests doctors look for.

- **Full blood count (FBC)**
- **White cell count (WCC)**
- **Platelets**
- **C-reactive protein (CRP)**
- **Urea and Electrolytes (U and E)**
- **Liver Function tests (LFT)**
- **Erthrocyte sedimentation rate (ESR)**



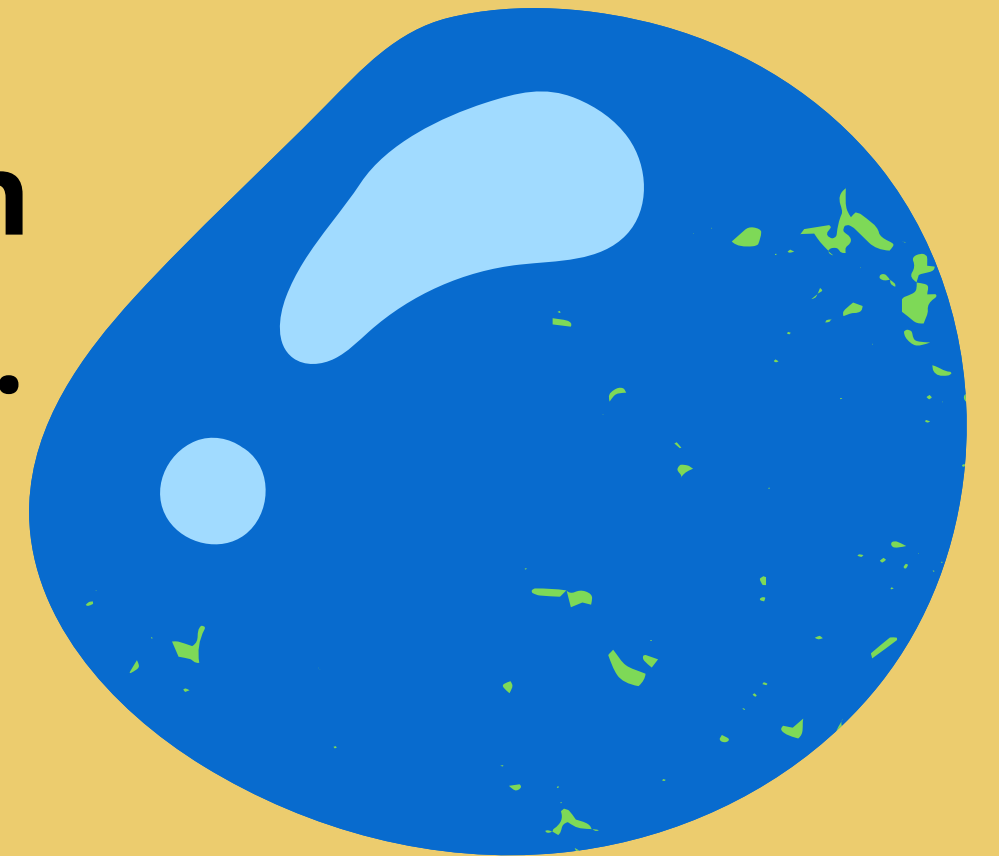
# **Urea and Electrolytes**

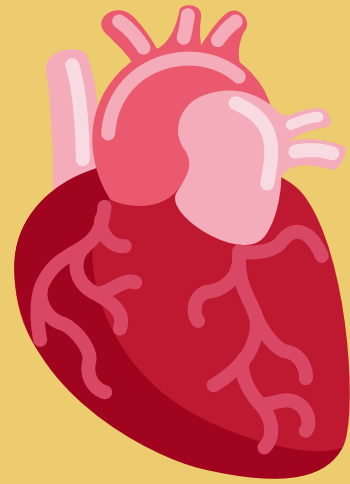
**Urea is a chemical that is made in the liver and removed from the body as URINE.**

**Electrolytes are minerals that are found in plasma. 70% of our body is made of water.**

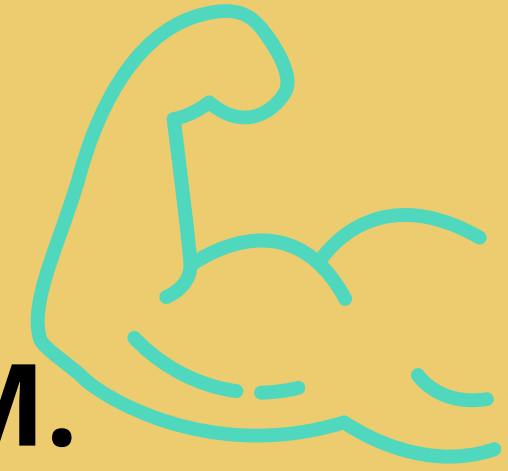
**Water inside the cells are called  
INTRACELLULAR FLUID (ICF).**

**Water outside the cells are called  
EXTRACELLULAR FLUID (ECF).**





# Electrolytes



The mineral found in ICF is **POTASSIUM**.

The mineral found in ECF is **SODIUM** and **CHLORIDE**.

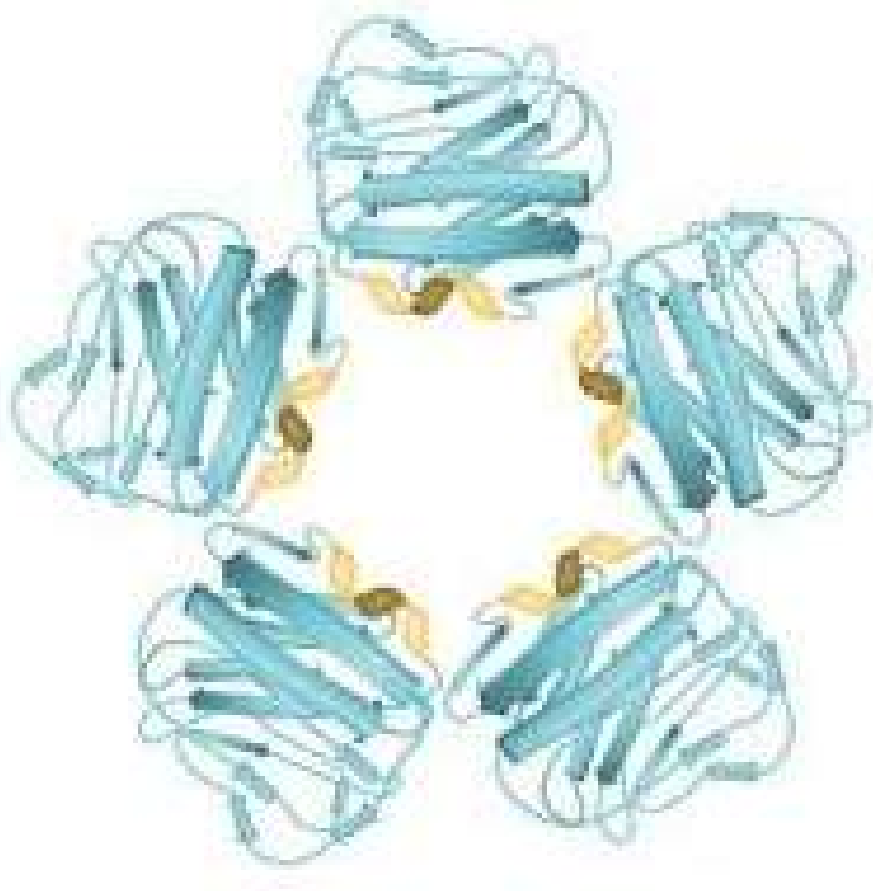
To maintain levels, there is a pump called **sodium-potassium pump**.

**This is important for the nerves,  
cardiac and muscles.**





# CRP



It is an inflammatory marker.

This means when there is an infection or inflammation, levels increase within 6 hours.

It can be used to monitor disease.

High levels 50-150 mg/l.

Severe >300 mg/l.

# CRP



**However, in  
leukaemia, there is  
little high CRP level  
despite  
inflammation.**



Obesity  
Cancer  
Infections  
Heart disease  
Diabetes  
Allergic reactions  
Sepsis



# ESR

Erthrocyte sedimentation rate.

An indirect meaasure of the rate of red blood cells.

**Red blood cells have a negative charge**  
**Plasma protein have a positive charge.**  
**The red blood cells stack up in an infection**



# **Tests depend on type of cancer.**

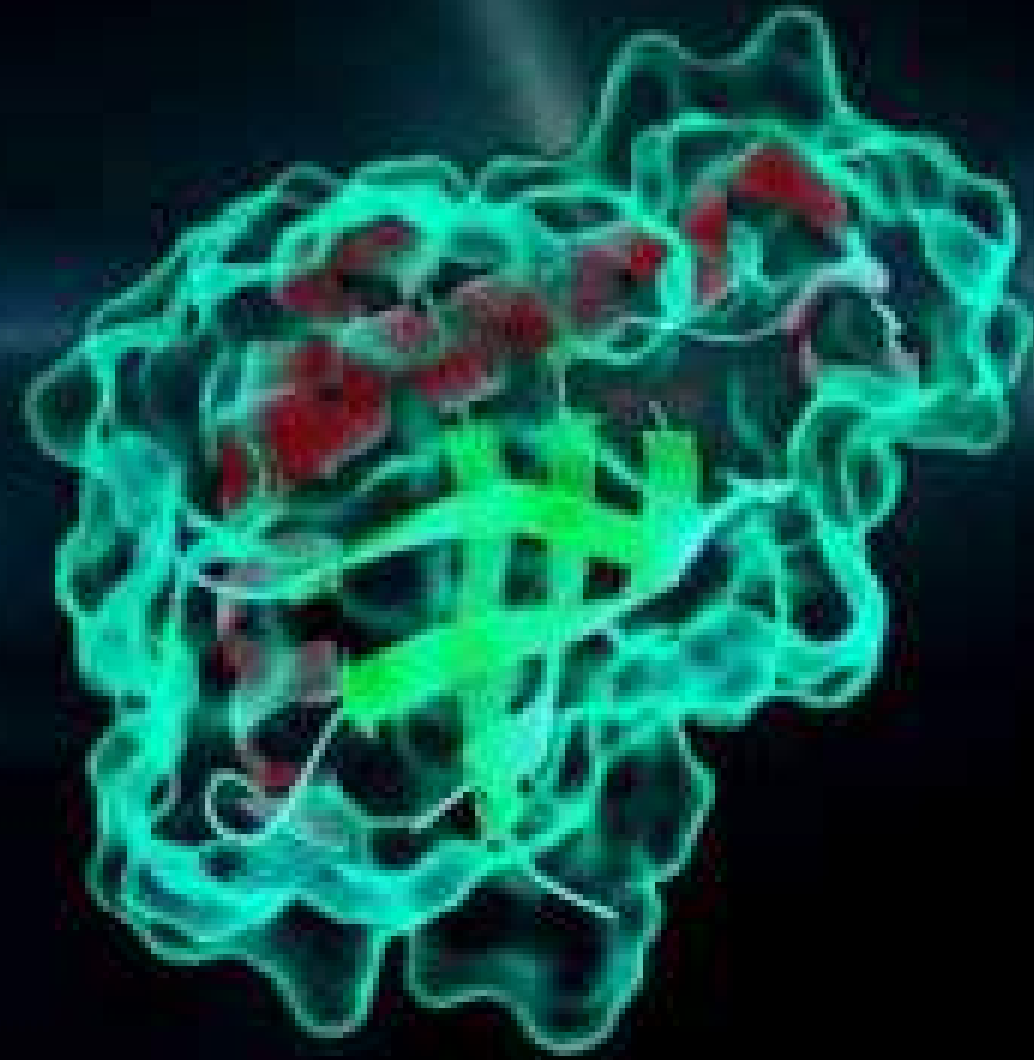
Depending on what the patient is experiencing in terms of symptoms, physical examination and medical history, certain tests are specifically done.

*Hodgkin's lymphoma would do extra tests on LDH,  
Alkaline phosphatase and creatinine.*

*Non-Hodgkin lymphoma would not and would test for  
CD25 level.*

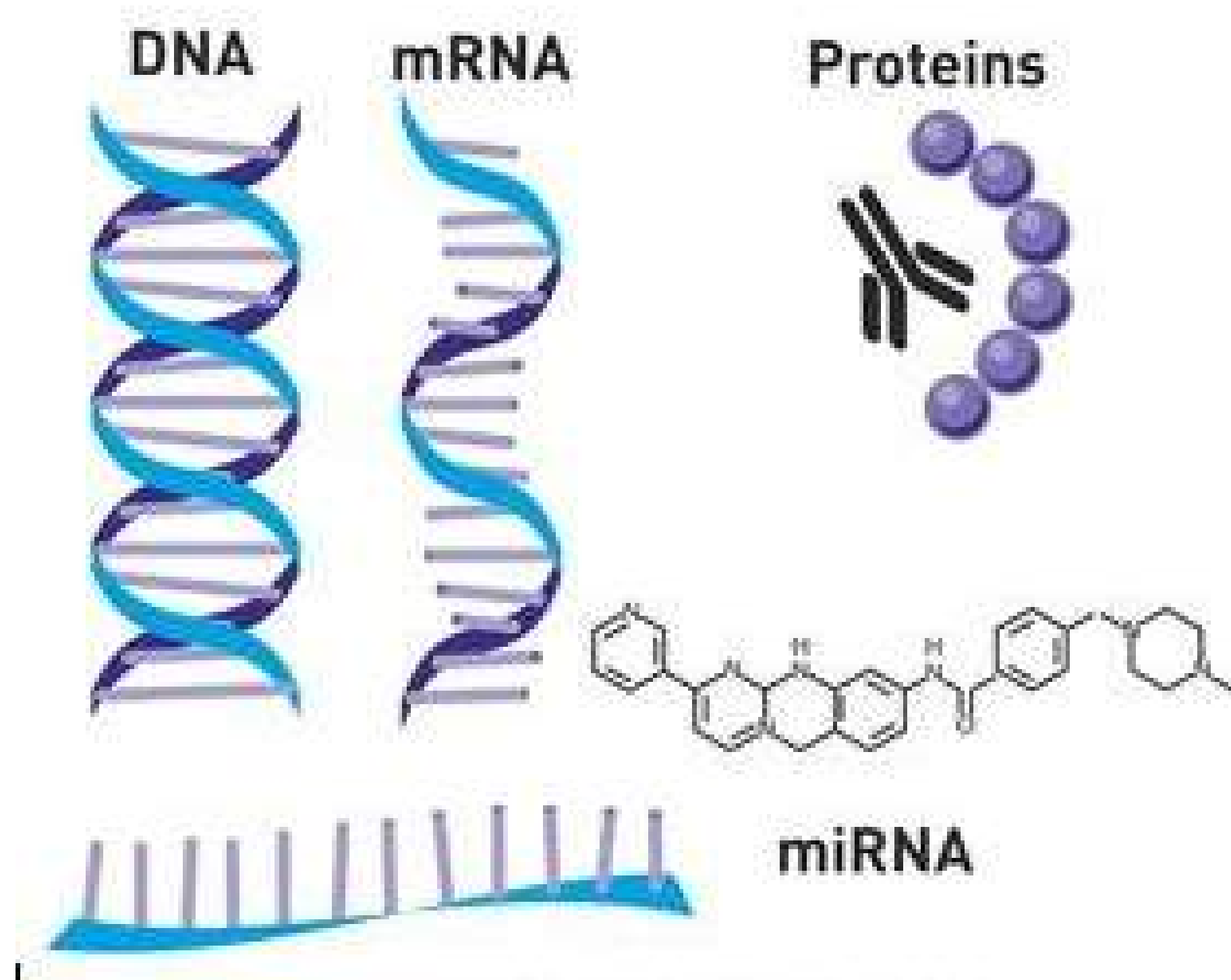
# What is a tumour biomarker

CA 15-3 breast cancer



A tumor marker is a substance found in the body tissues that can be elevated only in cancer cells

# Types of tumour biomarker



# Types of tumour biomarker

**Diagnostic** Specific for cancer.

**Prognostic** This increases with disease

**Predictive** The level is based on response to therapy.

**Response assessment**

Efficacy of the treatment



# CA-125



Monitor response to therapy.

80% of patients who had high levels of CA-125 had ovarian cancer.

# PSA

## Prostate-specific antigen

*It is a protein produced by normal prostate cells and also prostate cancer cells.*

*The PSA test are done on patients who have symptoms or at risk and above aged 45*

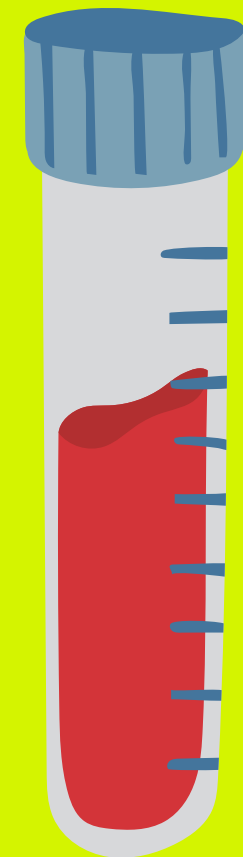


**Total PSA - screen and monitor prostate cancer.**  
**Free PSA - tell difference of prostate cancer with enlarged prostate.**

# PSA

**The amount of PSA is measured in nanogram of PSA per millilitre of blood (ng/ml)**

**A raised PSA level is 3 ng/ml or higher for a patient aged 50 to 69.**



# PSA

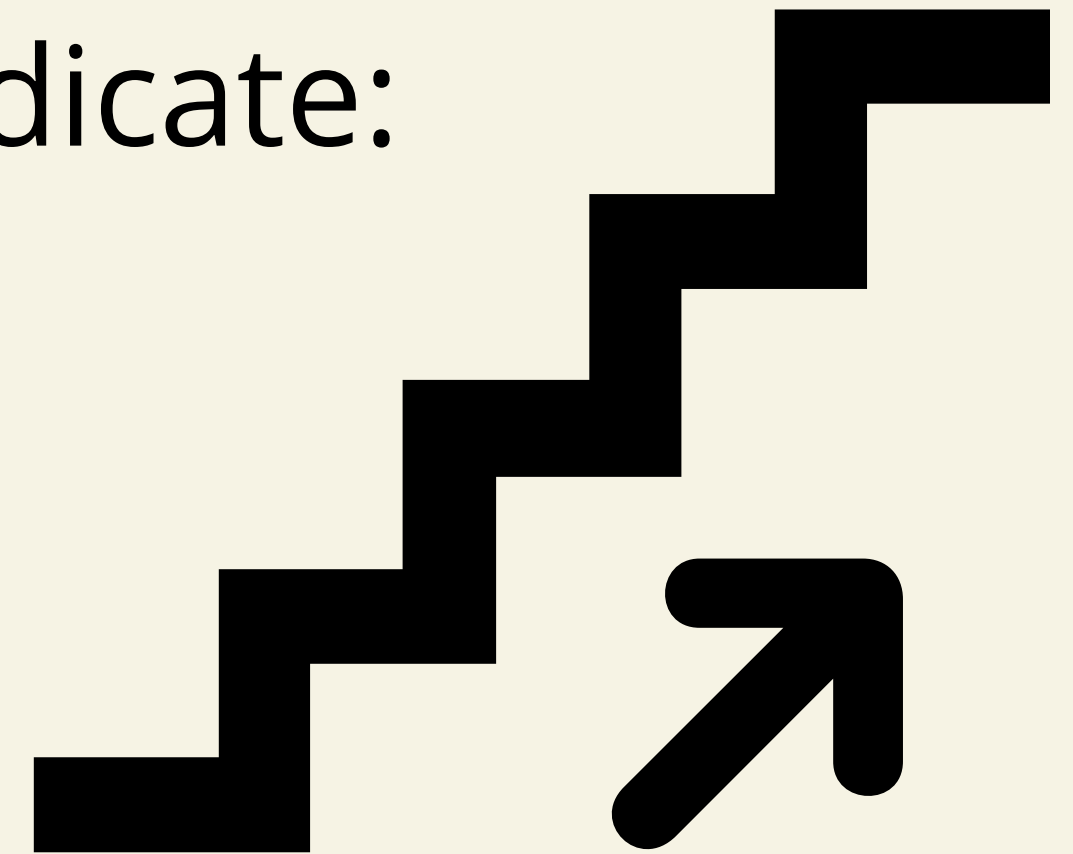
A raised PSA level could indicate:

**Large prostate**

**Urine infection**

**Cancer**

**Inflamed prostate (prostatitis)**



**ABOUT 3 IN 4 MEN WITH HIGH PSA WILL NOT HAVE CANCER!**



# **Tumour markers for germ cell tumours**

E.g. testicular cancer



**Monitor treatment of patients using the following prognostic markers.**

**Serum Alpha-fetaprotein (AFP)**

**Human chorionic gonadatrophin (HCG)**

**Lactate dehydrogenase (LDH)**

# CEA

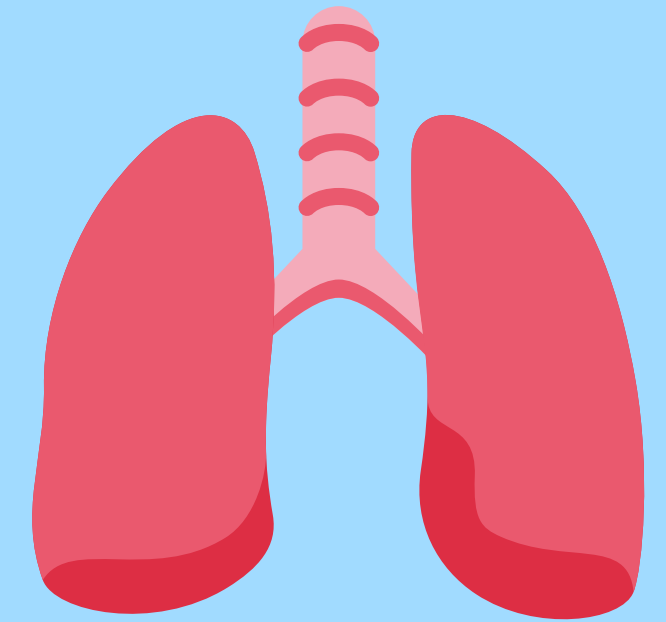
Serum carcinoembryonic antigen (CEA)



**Colorectal cancer**

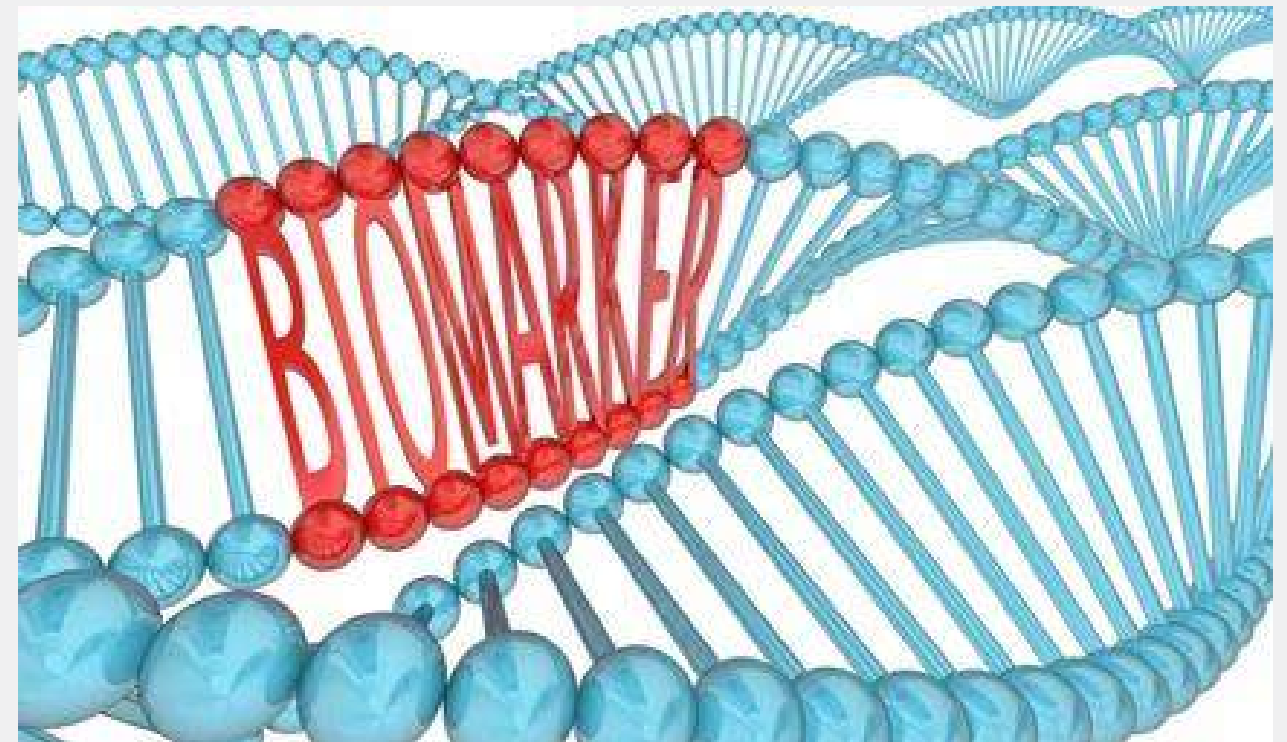
**Breast cancer**

**Non-small cell lung cancer (NSCLC)**



# Other tumour biomarkers

- ***NMP22 - monitor bladder cancer.***
- ***AFP - liver cancer***
- ***CA15-3 monitor recurrence of breast cancer.***
- ***serum thyroglobulin and calcitonin - thyroid cancer.***
- ***Urinary 5-hydroxyindoleacetic acid (5-HAA) - carcinoid tumours.***



# **Circulating Tumour cells**

- These are cells that circulate in the blood.**
- High levels in prostate and breast cancer cells.**
- They help predict survival in patients with advanced cancer.**
- They help in response to chemotherapy.**



## **Advantages of tumour markers**

Early signs of  
cancer get early  
treatment.

Increase survival.





## **Disadvantages of tumour markers**

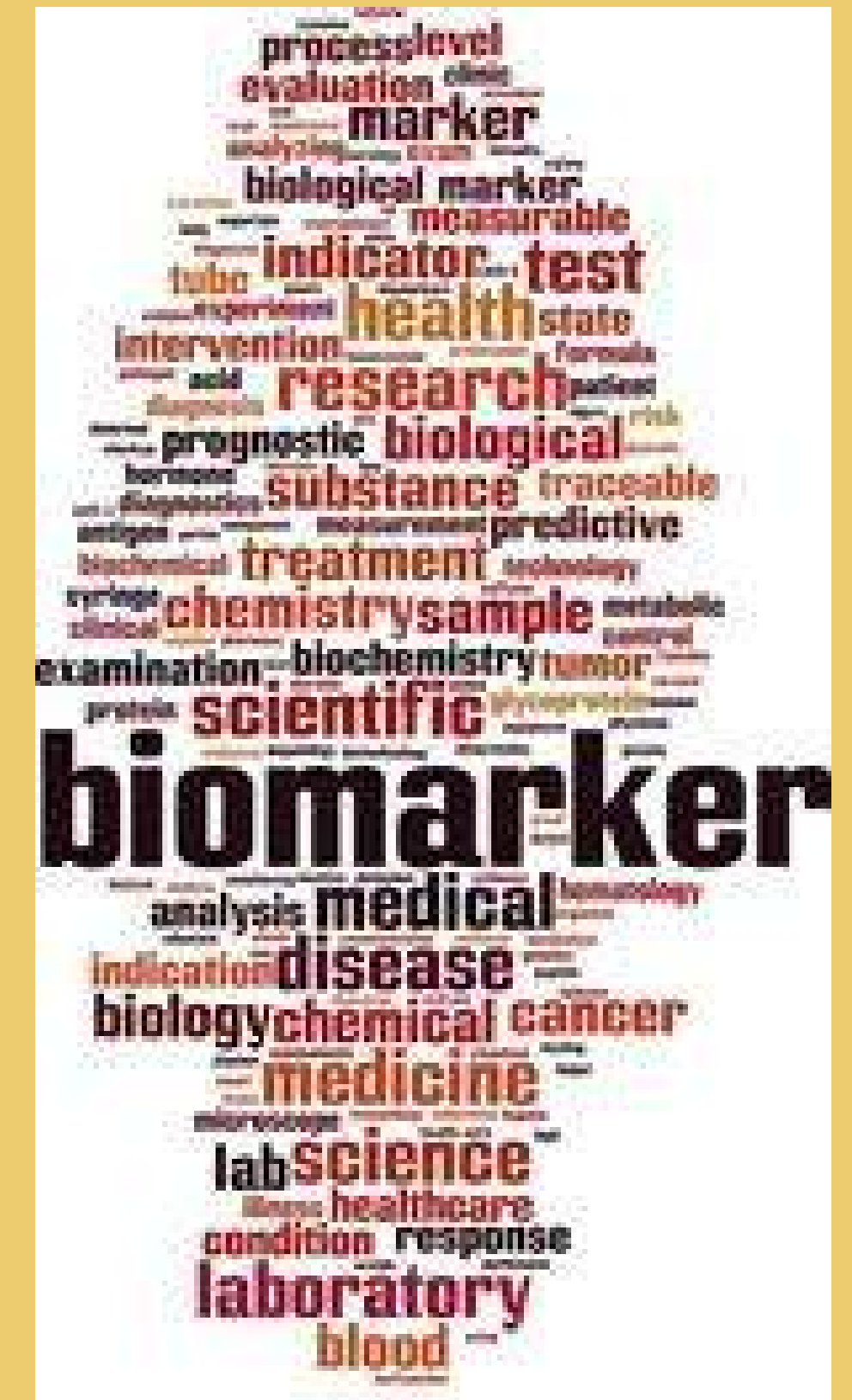
- **There is a chance it can miss cancer.**
- **It may lead to further tests when there is no cancer.**
- **Low marker levels in early stage cancer.**
- **Normal and tumour cells can produce most tumour markers and not specific enough.**
- **Proteins vary in cell types, disease states for each patient.**

**Blood and urine tests to detect biomarkers is an indication and further tests are required to confirm the cancer.**

# New biomarkers

Researchers are looking at other ways of finding biomarkers using:

- circulating miRNAs
- genomics - study of genes
- proteomics - study of proteins



**Potential  
prognostic markers!**  
New research has shown  
that MT1 and MT2 have  
low expression in  
advanced stages of non-  
small cell lung cancer  
(NSCLC).

← hope →

Open Access

Editorial

## New Biomarkers in Cancers

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(This article belongs to the Special Issue **New Biomarkers in Cancers**)



# Potential biomarkers!

Three genes FCN3, CLEC1B, PRC1  
have been found to help liver  
cancer patients of different survival  
rates: Overall, Progression-Free,  
Disease-Free survival.

→ believe →

**ORIGINAL RESEARCH** article

Front. Genet., 10 January 2020 |

<https://doi.org/10.3389/fgene.2019.01306>

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## Identification of Platform-Independent Diagnostic Biomarker Panel for Hepatocellular Carcinoma Using Large- Scale Transcriptomics Data



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**...and plenty more new  
research out there on  
biomarkers!**



**Overall, there are many tumour markers and more are investigated to help diagnose cancer and monitor treatment.**

## **COMMON TUMOR MARKERS**

- **CEA** - Monitor **colorectal**, breast, lung cancer
- **CA-125** - **Ovarian** cancer monitoring
- **CA15-3** - Monitor recurrences of **breast** cancer
- **AFP** - **Germ cell** tumors, **liver** cancer
- **Total PSA** - Screen and monitor **prostate** cancer
- **Free PSA** - Distinguish prostate cancer from BPH
- **HCG** - **Germ cell** and **trophoblastic** tumors
- **Hormone receptors** - **Breast** cancer therapy
- **NMP 22** - Monitor recurrences of **bladder** cancer



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*Part 9: Diagnosis - X-ray*

**UPCOMING VIDEO RELEASING SOON!**

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# Acknowledgements

**Oxford Handbook of Clinical Examination and Practical Skills.**

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**Novak, D. and Utikal, J. (2021) New Biomarkers in Cancers. Cancers, 13, 708.**

**Kaur H, Dhall A, Kumar R, Raghava (2020) GPS. Identification of Platform-Independent Diagnostic Biomarker Panel for Hepatocellular Carcinoma Using Large-Scale Transcriptomics Data. Frontiers of Genetics 10:10:1306**

**Nagpal, M., Singh, S., Singh, P., Chauhan, P., Zaidi, M. (2016) Tumour markers: A diagnostic tool. National Journal of Maxillofacial Surgery 7 (1) 17-20.**

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**Thank  
you!**