Biology Grade 8

Chapter 1: The Immune Response

INSTRUCTOR: SUHAIB AUDI

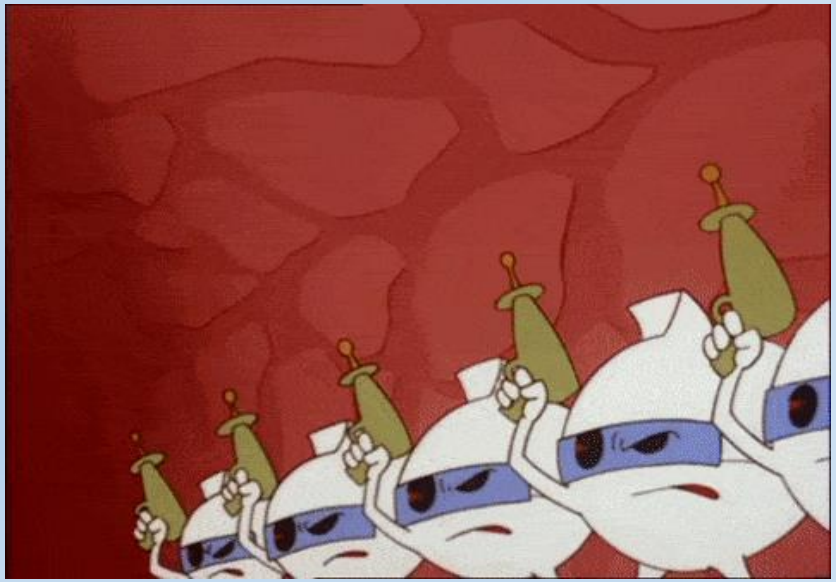
introduction

❑ Immunology:

Is the **scientific study of the immune system**, its functions, and how it defends the body against diseases. It explores how our bodies recognize harmful invaders and produce immune responses.

❑ The Immune system:

The immune system is like a highly trained army protecting our bodies from **pathogens**—harmful microorganisms such as bacteria, viruses, and fungi. It consists of different types of **cells, tissues, and organs** working together to defend against infections.

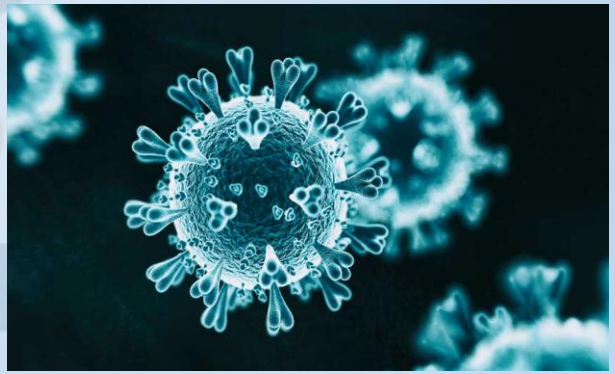


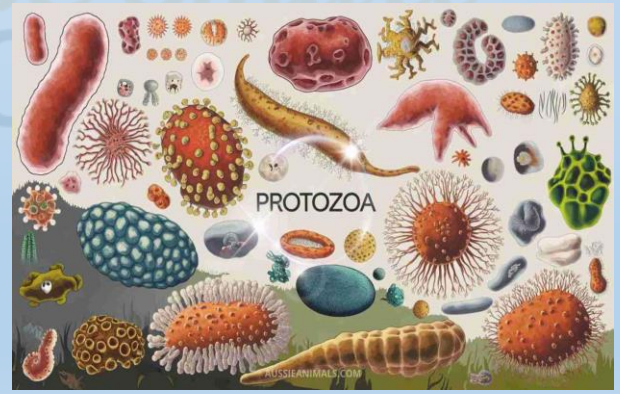
Microbes: The Tiny Living World

Microbes, also known as microorganisms, are living organisms that are too small to be seen with the naked eye. They exist everywhere—in the air, water, soil, and even inside our bodies.

Types of Microbes:

- Bacteria
- Viruses
- Fungi
- Protozoa
- Algae





Pathogenic vs. Nonpathogenic Microbes

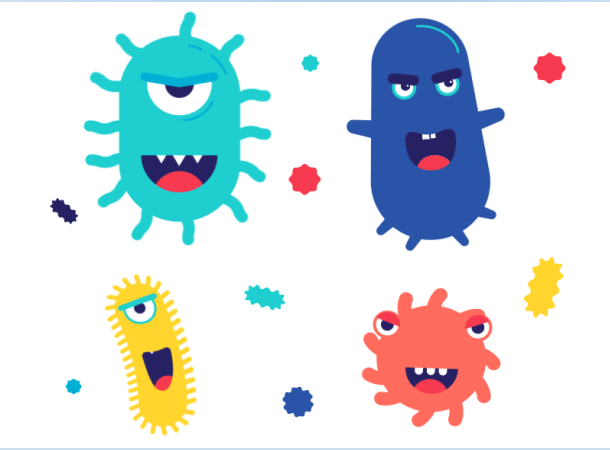
Microbes can be classified into two main groups based on their effects on living organisms:

1. Pathogenic Microbes (Harmful Microorganisms)

These are **disease-causing** microbes that invade the body and disrupt normal functions. They can be **bacteria, viruses, fungi, or protozoa**.

2. Nonpathogenic Microbes (Beneficial or Harmless Microorganisms)

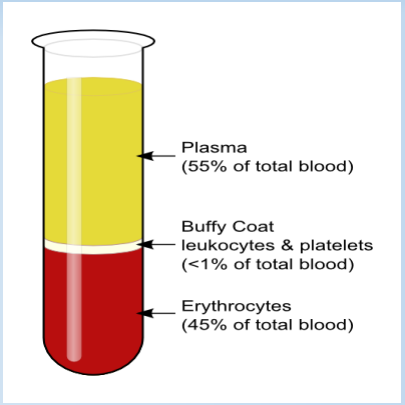
These microbes do **not cause disease**; many play beneficial roles in nature and human health.



❖ Constituents of Blood:

Blood is composed of: Blood cells and Plasma

- Plasma: is a liquid part, it helps the blood to flow. (55%)
- Blood cells: is a solid part (45%)

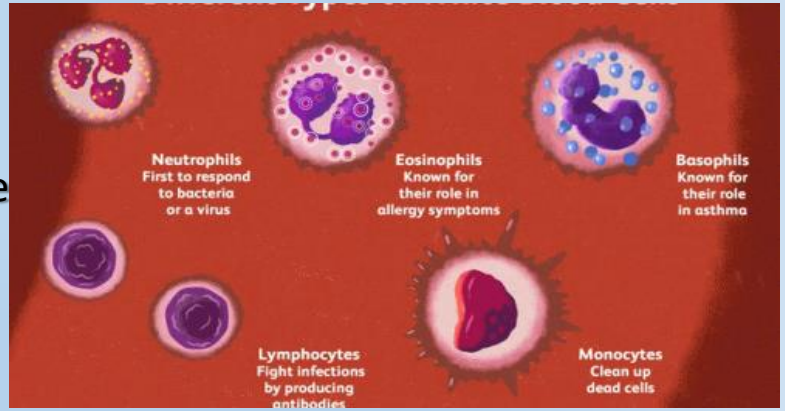


1. Red Blood Cells (RBCs) / Erythrocytes

- They have a disc shape.
- They are anucleated cells (they do not have a nucleus).
- They are responsible for transporting respiratory gases (O_2 and CO_2) between the lungs and the rest of the body.

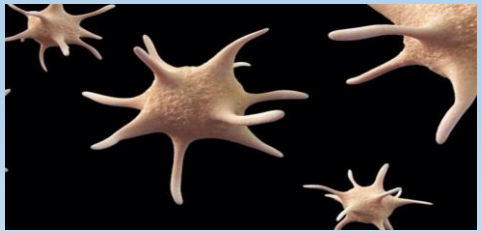
2. White Blood Cells (WBCs) / Leukocytes

- They are nucleated cells.
- They are responsible for defending the body against intruders such as pathogens (antige



3. Platelets

- They are responsible for blood clotting.
- They help close wounds and stop bleeding.




Red Blood Cell
White Blood Cell
Platelet

Activity 1: Self and Non-self

The immune system must distinguish between **self (body's own cells)** and **non-self (foreign invaders)** to protect the body while avoiding damage to healthy tissues.

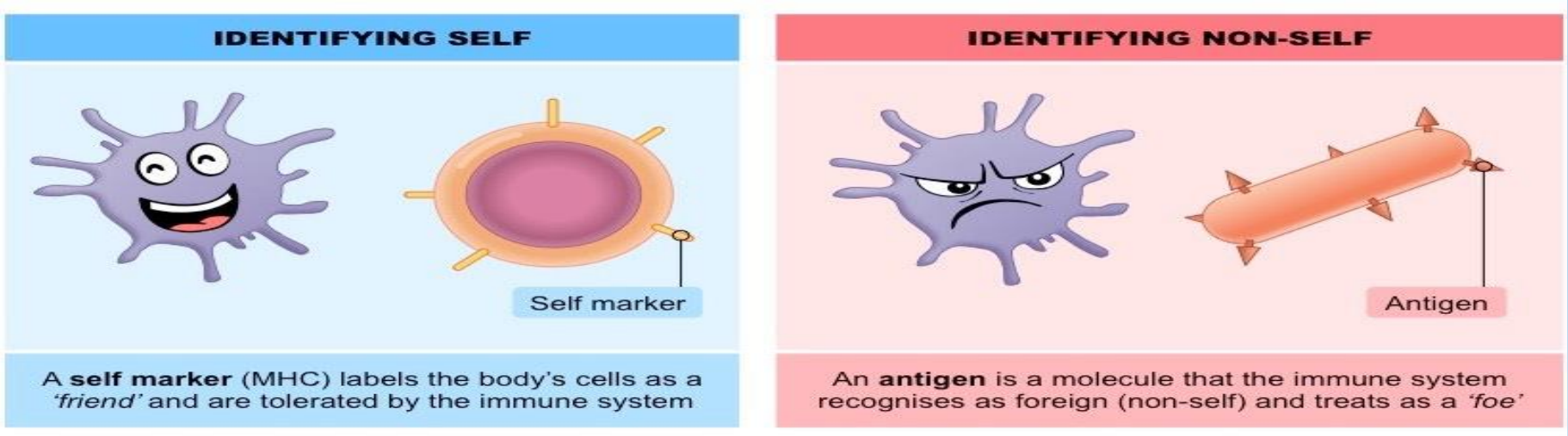
1. Self (Own Body's Cells)

All cells belonging to the body.

2. Non-Self (Foreign Invaders)

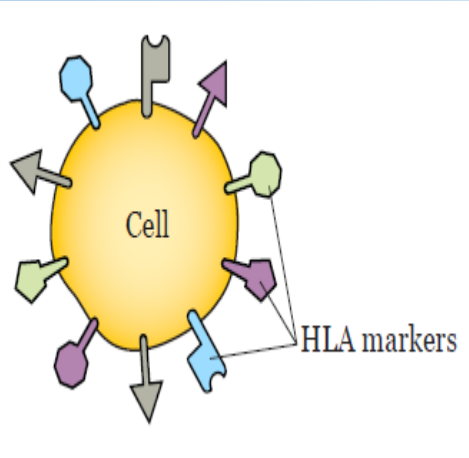
Any foreign entities, such as bacteria, viruses, and fungi.

Non-self-entities have **antigens**—unique molecules that alert the immune system to an invasion.



HLA molecule, a biological identity card

- The self is expressed at the membrane of every **nucleated cell** of the body by the presence of **HLA** molecule.
- HLA (Human Leukocyte Antigen) molecules are proteins found on the surface of cells that help the immune system distinguish between self and non-self. They are part of the Major Histocompatibility Complex (MHC) in humans.



❖ Characteristics of HLA molecules:

- HLA molecules are identical on the membrane of every nucleated cell in the same body.
- HLA molecules are different from one individual to another, except for identical twins.
- They represent a biological identity card and the unique identity for every individual.

❖ Grafting (Tissue Transplantation)

Grafting refers to the transplantation of tissues or organs from one individual to another. The immune system plays a crucial role in determining whether the graft will be accepted or rejected.

There are 4 types of graft:

- **Autograft:** is the transfer of cells, tissues or organs from one site to another in the same body.
- **Isograft:** is the transfer of cells, tissues or organs between identical twins.
- **Allograft:** is the transfer of cells, tissues or organs from one individual to another one within the same species.
- **Xenograft**: is the transfer of cells, tissues or organs between two individuals of different species .

Autograft

Garft in the same person from one part of body to other area like:

1. Skin graft
2. Hairs transplantation
3. Bone

Isograft

Between the identical twins

Allograft

This is between different members of the same species like:

1. Kidney transplantation
2. Heart
3. Lung
4. Liver

Xenograft

Between two different species Like monkey to man

Immune System’s Role in Graft Rejection

When a graft contains foreign **Human Leukocyte Antigens (HLA)** that do not match the recipient’s immune system, the body recognizes it as **non-self** and may attack it.

❑ Donor

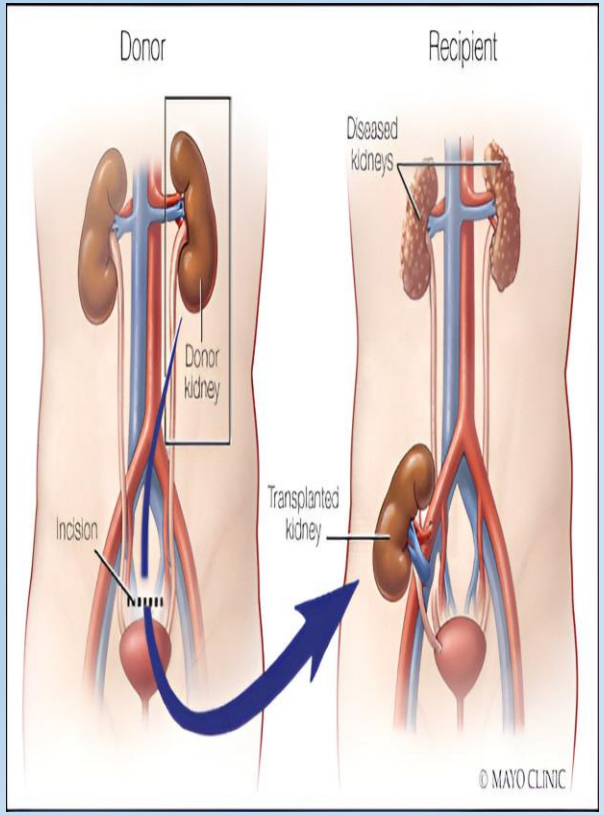
The individual who **provides** **the tissue or organ**.

Must have compatible HLA molecules to reduce the risk of rejection.

❑ Recipient

The individual who **receives** **the graft**.

The recipient's immune system may recognize the graft as non-self, leading to a risk of rejection.



- ✓ in the case of **Autograft** and **Isograft** the donor and the recipient have the **same HLA molecules**, so graft is recognized by the immune system as **self**, it is therefore accepted.

- ✓ in the case of **Allograft** and **Xenograft** the donor and the recipient **have different HLA molecules**, so graft is recognized by the immune system as **non self**, it is therefore rejected

Conclusion:

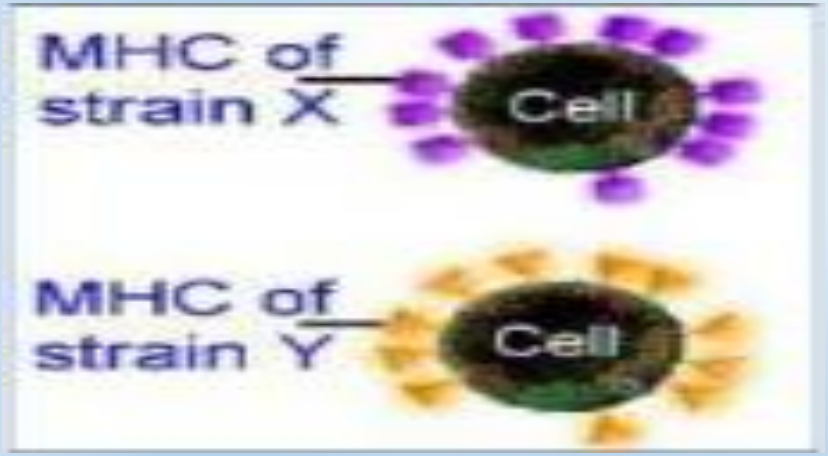
The success of a graft depends on the similarity of HLA molecules between the donor and the recipient.

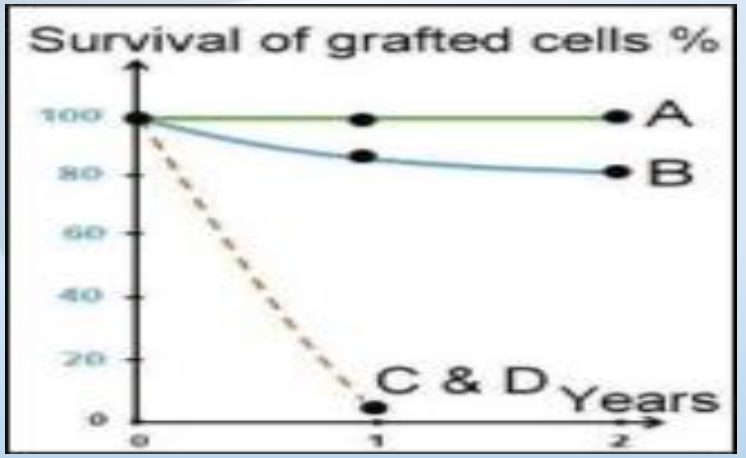
Exercise 1:

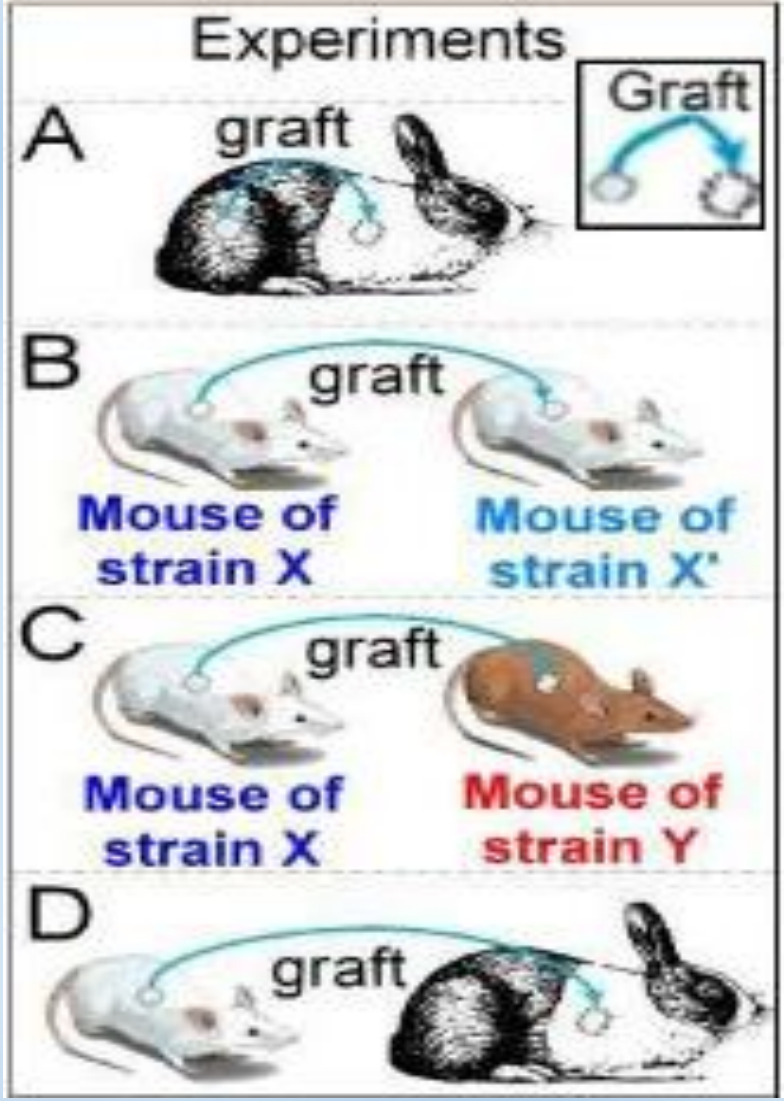
Doctors have known for many years about transplanting body parts such as blood vessels, heart, kidney or liver from a living organism to another, or inside the same organism.

Some grafts were accepted, others were rejected.

In their search for the factor(s) that lead to the rejection of the graft. They conduct the following graft experiments (A, B, C & D) & the results were summarized in the graph below.







a- Pose the problem question.

What are the factors that lead to the rejection of the graft?

b- Pick out the organs that can be grafted.

Blood vessels, heart, kidney or liver

c- Referring to your knowledge, determine the type of each graft

A: Since the graft is done from one site to another in the same body, so it

is an autograft.

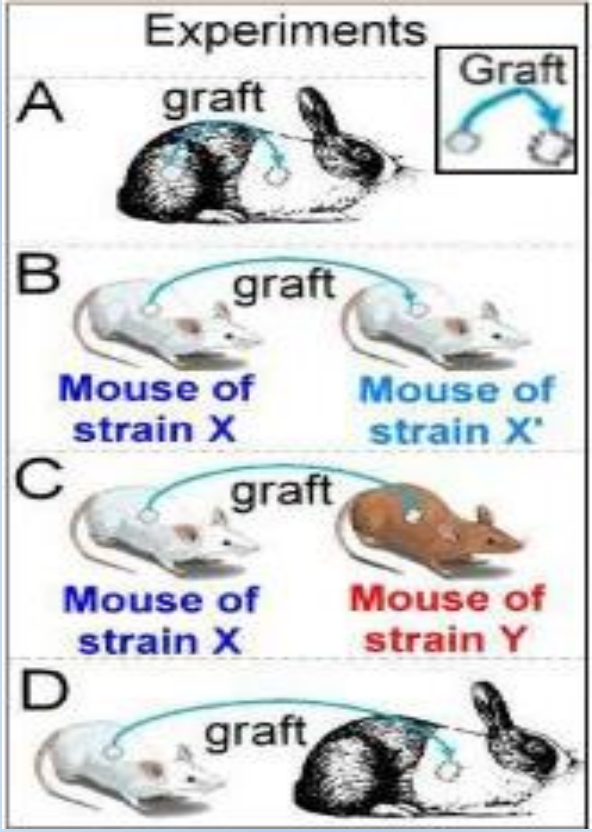
B: Since the graft is done between identical mice, so it is an isograft.

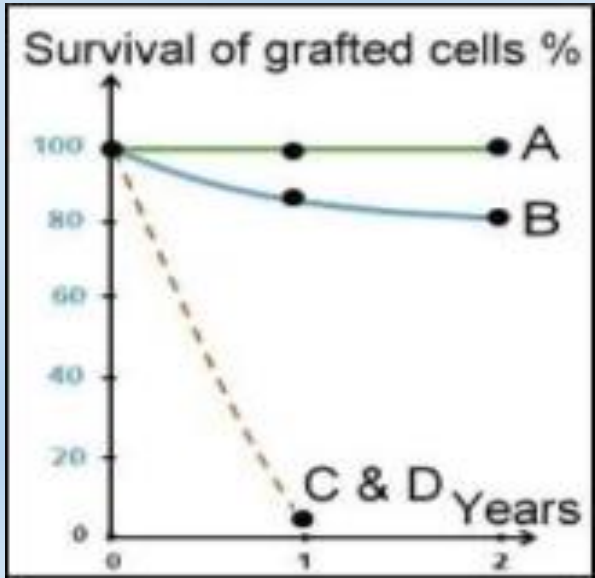
C: since the graft is done between two different mice (X and Y), so it is an allograft.

D: Since the graft is done between two different animals of different species (mouse and rabbit), so it is a xenograft.

d- Analyze all conducted experiments.

As time passes from 0 to 2 years, the % of graft cell survival between 2 sites of rabbit body remains constant at 100% while the graft between mice of same strain X slightly decreases from 100% to 80%. Whereas both grafts between mouse of strain X & mouse of strain Y & the graft between mouse strain X & the rabbit decrease from 100% to reach 2%.





e- Derive a conclusion concerning the fate (accepted or rejected) of each graft

A: accepted B: accepted C: rejected D: rejected

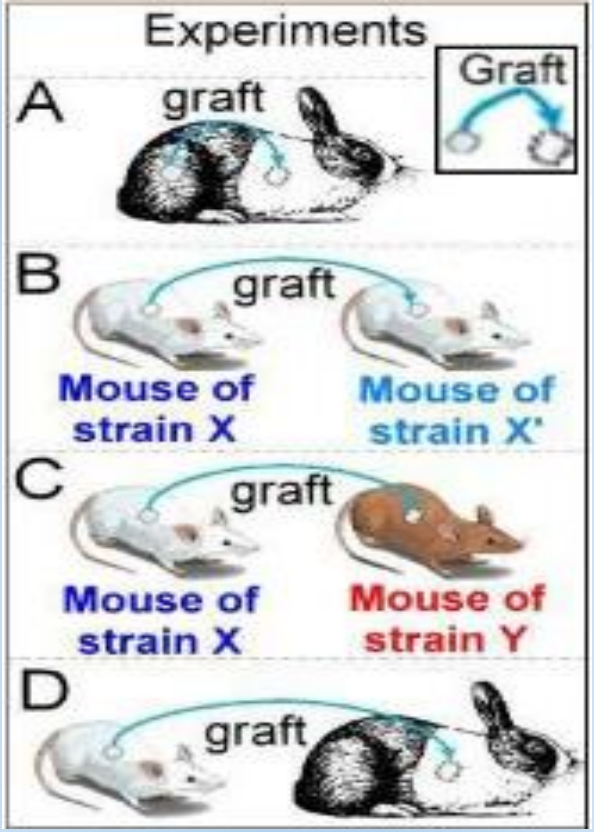
f- Using all previous documents, draw out the suitable conditions for the success of the graft.

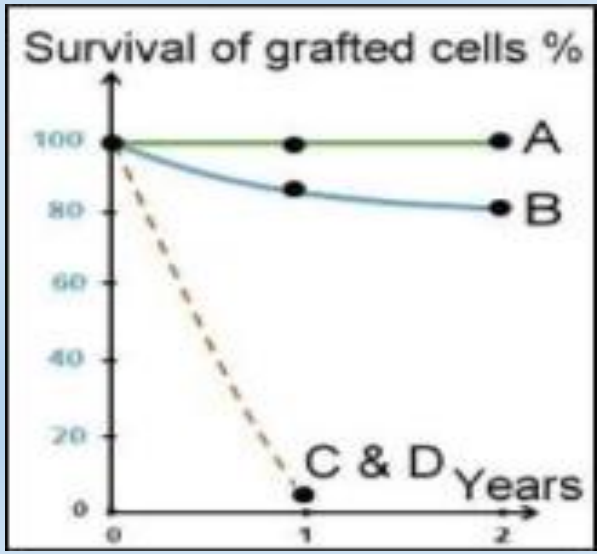
The similarity between of MHC between the donor and the recipient.

g- Tabulate the obtained result.

years		0	1	2
Survival	A	100	100	100
of grafted	B	100	90	80
cell	C and D	100	2	-

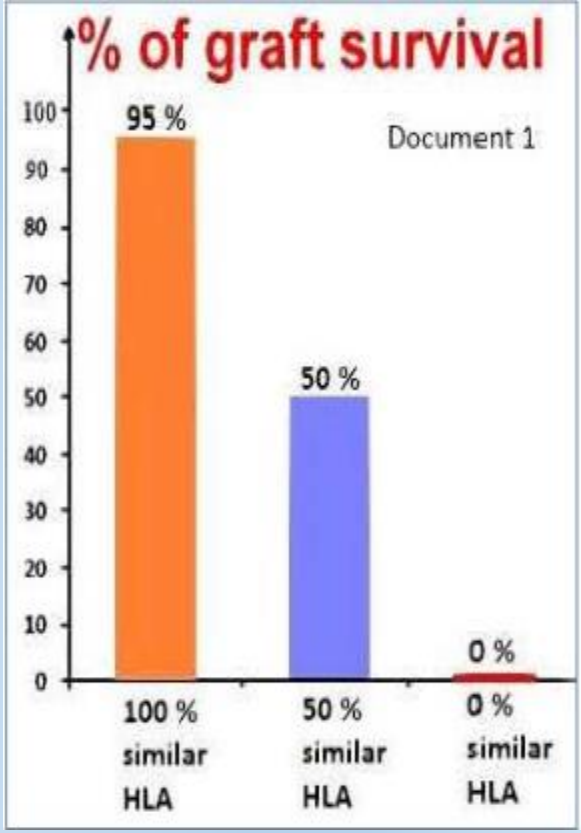
Title: this table shows the variation of the % of graft cells survival in different cases as a function of years.





Exercise 2: THE REJECTION OF GRAFTS

What are the elements of the body that are responsible for the success or the rejection of the graft? In order to answer this problem, scientists measured the % of survival of the graft done for individuals subjected to kidney graft after one year. The results are shown in document 1.



1- Pick out the problem studied by the scientists.

What are the elements of the body that are responsible for the success or the rejection of the graft?

2- Formulate a hypothesis concerning this problem.

Hypothesis: the difference in HLA between the donor & the recipient causes the rejection of the graft.

3- Convert the given histogram into a table.

HLA similarity	100%	50%	0%
% of graft survival	95	50	0

Title: This table shows the % of graft survival as a function of similarity of HLA after one year.

4- Compare the obtained results.

The % of the survival of graft at 100% HLA similarity is (95%) which is **greater than that** at 50% HLA similarity which is (50%) **greater than that** at 0% similarity which is (0%).

5- Derive a conclusion concerning the element that is responsible for the rejection of the graft.

Incompatible HLA is responsible for the graft rejection..