UNIT 5 SOLDIERS OF DEFENSE

DEFENSE

Defence is the ability of the body to prevent the entry of pathogens and to destroy those that have already entered the body.

DEFENSE MECHANISMS

The defense mechanism in our body can be classified into two, namely non – specific defense mechanism and specific defense mechanism.

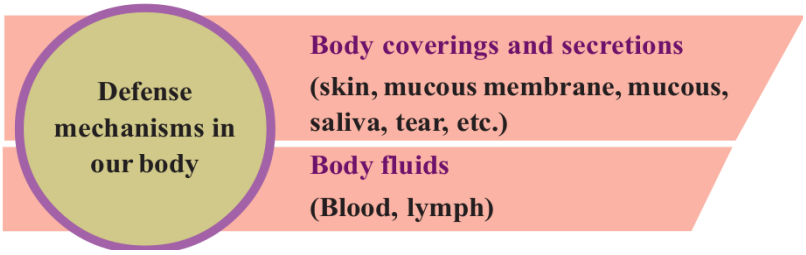
Non – specific defense mechanism

Non-specific defense mechanism is a mechanism that protects us from all pathogens without considering their characteristic features.

Specific defense mechanism

The defense mechanism that identifies the structure of each antigen and destroys it specifically is called specific defense.

NON – SPECIFIC DEFENSE MECHANISM

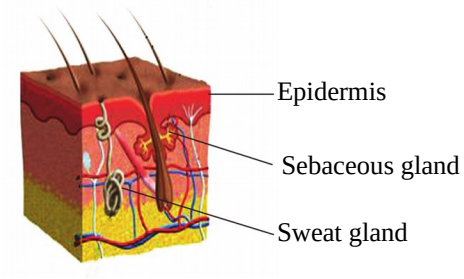


BODY COVERINGS

- Skin and mucous membrane are protective covering of body parts.
- Coverings of the body act as a habitat for many useful bacteria.
- The germs that enter the body need to compete with such useful bacteria for shelter and nutrients.
- A great number of germs get destroyed in this competition.

Skin

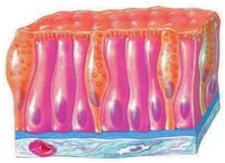
- Skin is the protective covering of the body.
- It is a safety shield that prevents the entry of germs.



Part of skin	Defensive mechanism	Function
Epidermis	Keratin	Prevents entry of germs
Sebaceous gland	Sebum	Makes the skin oily and water proof
Sweat gland	Sweat	The disinfectants present in sweat destroys the germs

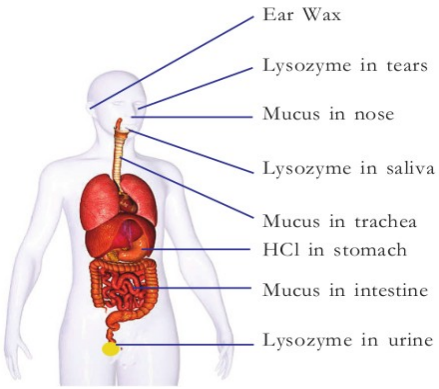
Mucous membrane

- Produce mucous
- Pathogens trapped in the mucous get destroyed
- The destroyed germs are expelled out by the cilia cells of the mucous membrane.



BODY SECRETIONS

- Body secretions destroy germs.



Part of the body	Secretion
Ear	Wax
Eye	Lysozyme in tears
Nose	Mucous in nose
Mouth	Lysozyme in saliva
Trachea	Mucus
Stomach	HCl
Intestine	Mucus
Urinary tract	Lysozyme in urine

MODEL QUESTIONS AND ANSWERS

1. A table indicating body secretions and defense mechanisms is given below. Arrange column B based on column A.

A	B
i. Skin	a. Wax
ii. Trachea	b. HCl
iii. Ear	c. Sebum
iv. Stomach	d. Mucus

ANSWER KEY

1.

A	B
i. Skin	c. Sebum
ii. Trachea	d. Mucus
iii. Ear	a. Wax
iv. Stomach	b. HCl

BODY FLUIDS

- Body fluids like **blood** and **lymph** play an important role in defence mechanism.
- Body fluids follow different defence strategies
  - control the entry of germs into the body
  - neutralise germs and the toxic substances they produce
  - prevent multiplication of germs

ROLE OF BLOOD IN THE DEFENSE SYSTEM

Blood plays a major role in the defence system.

◆ White blood cells and Defence Action

- White blood cells play a significant role in defense.

White blood cells	Defence action
Neutrophil 	- Engulfs bacteria - Synthesizes chemicals that destroy bacteria
Basophil 	- Stimulates other white blood cells - Dilates the blood vessels
Eosinophil 	- Synthesizes chemicals that destroy foreign bodies - Synthesizes chemicals requires for the inflammatory responses
Monocyte 	- Engulfs and destroys germs
Lymphocyte  B Lymphocyte  T Lymphocyte	- Identifies and destroys germs specifically

MODEL QUESTIONS AND ANSWERS

1.Which among the following is the odd one ? Why ?

Monocyte, Neutrophil, Eosinophil, Lymphocyte, Basophil

ANSWER KEY

1.Lymphocyte

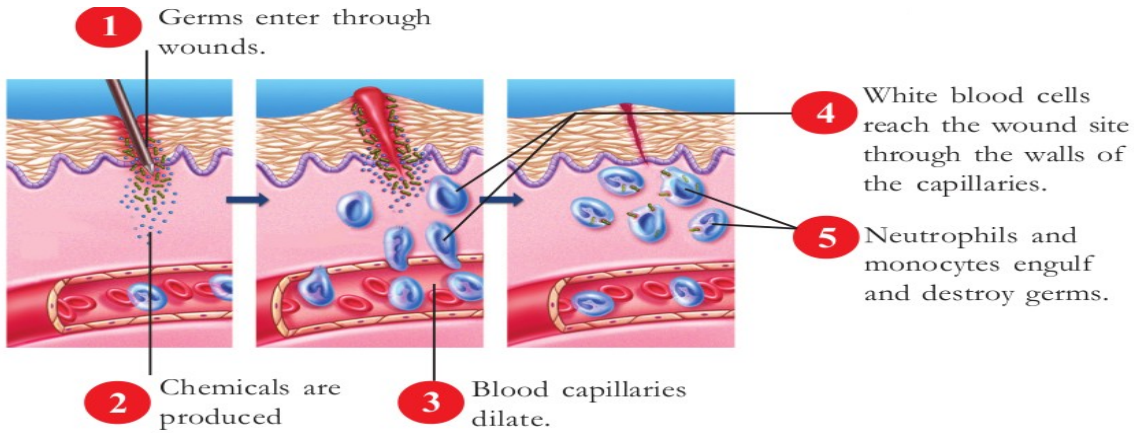
Involved in specific defense

◆ Inflammatory Response

- When a wound occurs, that part swells up. This is called inflammatory response.

Stages of Inflammatory response

- Wound or infection occurs.
- Germs enter through wound.
- Cells that get damaged by wound or by an infection produce certain chemical substances.
- These chemical substances dilate the blood capillaries.
- Blood flow increases and blood plasma and more white blood cells reach the wound site through the walls of the capillaries which results in the swelling of wound site.
- Neutrophil and monocytes engulf and destroy germs.



The advantage of dilation of capillaries at the wound site

As a result of the dilation of capillaries, blood flow increases and blood plasma and more white blood cells reach the wound site through the walls of the capillaries. The neutrophils and monocytes engulf and destroy germs.

Role of white blood cells in the inflammatory response

Eosinophil – Synthesizes chemicals required for the inflammatory responses.
Basophil - Dilates the blood vessels
Neutrophil and Monocytes - Engulf and destroy germs

MODEL QUESTIONS AND ANSWERS

1. When there is injury or wound, the blood vessel of that part dilates.
   (a) What is its benefit ?
   (b) Which white blood cell dilates the blood vessel ?

ANSWER KEY

1.
(a) When the blood vessel dilate the blood flow increases. Blood plasma and more white blood cells reach the wound site.

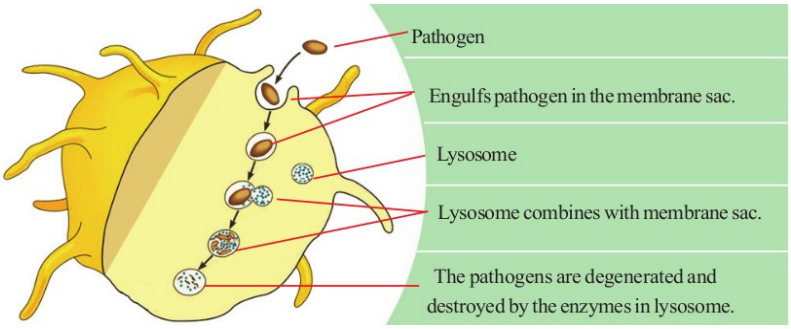
(b) Basophil

- **Phagocytosis**

- Phagocytosis is the process of engulfing and destroying of germs.
(Phago – to engulf, cyte - cell)
- Phagocytes – The cells that are engaged in the process of phagocytosis.
Example : Monocytes, Neutrophil

Stages of Phagocytosis

- Phagocytes come near pathogens
- Engulfs pathogen in the membrane sac
- Lysosome combines with membrane sac
- The pathogens are degenerated and destroyed by the enzymes in lysosome
- Remnants are expelled



MODEL QUESTIONS AND ANSWERS

1. Observe the given illustration and answer the questions.

(a) Which is the process indicated in the illustration ?

(b) Which are the white blood cells involved in the process ?

ANSWER KEY

1.

(a) Phagocytosis

(b) Monocytes

Neutrophil

◆ Blood clotting

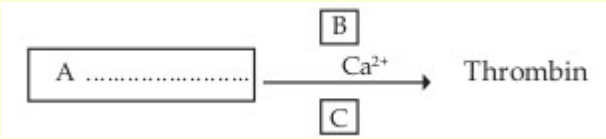
- Blood clotting is also a defense mechanism.
- Blood clotting helps to prevent bleeding and checks the entry of pathogens through wounds.

Stages in the process of blood clotting

- Tissues and platelets at the site of wound degenerate to form the **enzyme** called **thromboplastin**.
- Thromboplastin converts **prothrombin** in plasma **to thrombin**. For this process to occur **vitamin K** and **Calcium** is needed.
- **Thrombin** converts **fibrinogen to fibrin fibres**
- The red blood cells and platelets get entangled in the network of fibrin fibres to form the blood clot.

MODEL QUESTIONS AND ANSWERS

1. Observe the illustration related with blood clotting and answer the questions.



(a) Identify A.

(b) B is a vitamin and C is an enzyme. Name them.

ANSWER KEY

1.

(a) Prothrombin

(b) B – Vitamin K

C – Thromboplastin

◆ Healing of wounds

- Healing of wound is a stage after inflammatory response and blood clotting.
- Infections through the wound slow down the healing process.
- A strong defense system accelerates the process of wound healing and reduces the chance of infection.

Appearance of wound scar

*When a wound occurs **new similar tissues are formed in place of the tissues damaged** or lost by the wound. In such situations **wound scar does not remain**.

*In cases **when new similar tissues cannot be formed**, the **connective tissue heals the wound**. In such situations, the **wound scar remains.**

MODEL QUESTIONS AND ANSWERS

1. The scars of a cycle accident were totally disappeared from Appu's hand, but scar of burning remains even after 10 years. What explanation would you give for these two situations ?

ANSWER KEY

1. When a wound occurs new similar tissues are formed in place of the tissues damaged or lost by the wound. In such situations the wound scar does not remain.

But, in cases when new similar tissues cannot be formed, the connective tissue heals the wound. In such situations, the wound scar remains.

- **Fever**
  - Normal body temperature is 37^0C (98.6^0F).
  - Fever is a condition when the body temperature rises above the normal level.
  - Fever is a defense mechanism of the body.

Fever as a defense mechanism

Pathogens enter the body

↓

Pathogens produce toxins

↓

Presence of these toxins stimulates the white blood cells

↓

White blood cells produce chemical substances

↓

These chemical substances raises body temperature

↓

The rise in body temperature

- reduces the rate of multiplication of pathogens
- increases the effect of phagocytosis

- When infection becomes uncontrollable, the body temperature may rise tremendously.

Fever is a defense mechanism. Then why do we take medicines during fever ?

- If the rise in body temperature persists for a long time, it may badly affect the internal organs including the brain. Hence, if fever increases, it is necessary to seek medical assistance immediately.

MODEL QUESTIONS AND ANSWERS

1. The steps getting fever as a defense mechanism are given below. Arrange them in correct sequence.

(a) Body temperature raises

(b) Pathogens enter the body

(c) Pathogens produce toxins

(d) White blood cells get stimulated and produce chemical substances

ANSWER KEY

1.

(b) Pathogens enter the body

(c) Pathogens produce toxins

(d) White blood cells get stimulated and produce some chemical substances

(a) Body temperature raises

SPECIFIC DEFENCE MECHANISM

- **Antigens**

  Foreign bodies or pathogens that enter the body and stimulate the defense mechanism are called antigens.

- **Antibodies**

  - Proteins produced by B – Lymphocytes
  - Act against antigens

- **Lymphocytes**

  - Lymphocytes are the blood cells that specifically identify and destroy pathogens that enter the body by overcoming the non- specific defense mechanism of the body.

Type of lymphocyte	Formed in	Mature in	Defense actions
B Lymphocytes	Bone marrow	Bone marrow	Produce **antibodies** which destroy the pathogens in the following ways - Destroy the bacteria by disintegrating their cell membrane. - Neutralise the toxin of the antigens. - Destroy the pathogens by stimulating other white blood cells.
T Lymphocytes	Bone marrow	Thymus gland	- Stimulate other defense cells of the body. - Destroy the cells affected by virus. - Destroy cancer cells.

MODEL QUESTIONS AND ANSWERS

1.White blood cells play an important role in specific defence mechanism.

(a) Which are the white blood cells that act as part of specific defence mechanism ?

(b) Where does it mature ?

(c) What is the role of antibodies in specific defense mechanism ?

2. Rearrange the column B in accordance with column A.

A	B
Neutrophil	Destroy cancer cells
Basophil	Engulfs pathogens
B Lymphocyte	Helps in oxygen transport
T Lymphocyte	Produces antibodies
	Dilates blood vessels

ANSWER KEY

1.

(a) Lymphocytes (B -Lymphocytes, T – Lymphocytes)

(b) B -Lymphocytes - mature in bone marrow

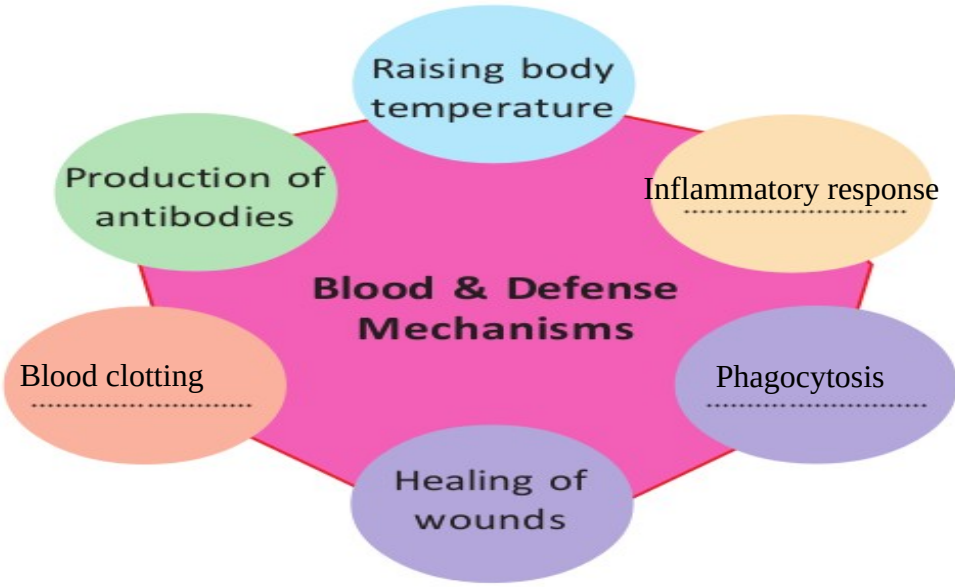
T – Lymphocytes – mature in Thymus gland

(c) Antibodies destroy the pathogens in three different ways.

- destroy the bacteria by disintegrating their cell membrane
- neutralise the toxin of the antigens
- destroy the pathogens by stimulating other white blood cells.

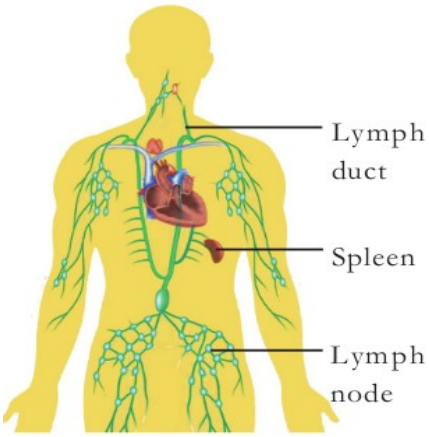
2.

A	B
Neutrophil	Engulfs pathogens
Basophil	Dilates blood vessels
B Lymphocyte	Produces antibodies
T Lymphocyte	Destroy cancer cells



LYMPH AND DEFENSE

- Lymph is the tissue fluid inside the lymph capillaries.
- Lymph is formed from blood and reabsorbed into blood.
- Lymph contains plenty of lymphocytes. They destroy the disease causing bacteria in lymph nodes and spleen.
- Parts of lymphatic system – Lymph duct, Lymph node, Spleen, Lymph



IMMUNIZATION

- **Immunization**
  Immunization is the artificial method to make the defense cells alert against the attack of pathogens.

- **Name the scientist who introduced the method of immunization**
  Edward Jenner

- **Cowpox experiments of Jenner**
  Edward Jenner, an English doctor, observed that people affected by cowpox escaped from the attack of small pox. He injected the pus taken from a cowpox patient into the body of an 8 year old boy. The boy was affected by cowpox and recovered. After two months the pus taken from a small pox patient was injected into the boy. He was not affected by small pox.

-The immunization programmes got the name vaccination from the latin word ' **Vacca** ' meaning **cow**.

- **Vaccine**
  Vaccines are the substances used for artificial immunization.

- **Components of vaccines**
  Any one of the components from
  - alive or dead or neutralised germs
  - neutralised toxins
  - cellular parts of the pathogens

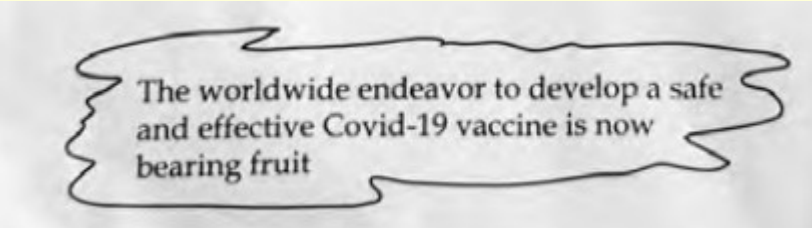
- **Significance of vaccination**
  Defense mechanisms become slow when germs enter the body. This causes the spread and multiplication of germs. Components in vaccines make the defense cells alert against the attack of pathogens.

- **How do vaccines induce immunity ?**
  - Components in vaccine act as antigens that that stimulate the defense mechanism of the body.
  - Antibodies are formed in the body against them.
  - These antibodies are retained in the body which in future protects the body from the pathogen responsible for the same disease.

Vaccine	Disease
B C G	Tuberculosis
O P V	Polio
Pentavalent	Diphtheria, Pertusis, Tetanus, Hepatitis B and Haemophilus influenzae type B
M M R	Measles, Mumps and Rubella
T T	Tetanus

MODEL QUESTIONS AND ANSWERS

1. Observe the news given below and answer the questions.



(a) What are vaccines ?

(b) Write any two components used in vaccines ?

(c) Name the scientist who introduced the method of immunization.

ANSWER KEY

1.

(a) Vaccines are the substances used for artificial immunization.

(b) - alive dead or neutralised germs
- neutralised toxins
- cellular parts of the pathogens

(Any two)

(c) Edward Jenner

TREATMENT

- Medical treatment becomes necessary when we are affected by diseases, crossing all obstacles of our immune system.

- **DIFFERENT METHODS OF TREATMENT**

In various parts of the world, methods of treatment have evolved in accordance with the lifestyle of the people, their culture and available natural resourses.

Examples

- Ayurveda
- Modern medicine
- Homeopathy
- Siddha
- Unani
- Naturopathy
- Panchakarma

Ayurveda	- famous method of treatment emerged from India. - plant and animal products are used as medicines. - to maintain an efficient and healthy body live in harmony with nature is necessary.
Homeopathy	- Proposed by German doctor, Sammuel Haniman.
Modern medicine	- Hippocrates paved the way for modern medicine. - discarded superstitious beliefs and emphasized only on pathogens, diagnosis and medicines.

MODEL QUESTIONS AND ANSWERS

1. Analyse the indicators given below and name the method of treatment indicated.

(a) Method of treatment proposed by German doctor, Sammuel Haniman.

(b) Treatment system that discarded superstitious beliefs and emphasized only on pathogens diagnosis and medicine.

ANSWER KEY

1.

(a) Homeopathy

(b) Modern medicine

DIAGNOSIS

EQUIPMENTS

Equipment	Use
Stethoscope	to listen to the sounds made by the heart, lungs or intestines
Thermometer	to measure body temperature
Sphygmomanometer	to measure blood pressure
Electro Encephalo Graph (EEG)	to record electric waves in the brain
Electro Cardio Graph (ECG)	to record electric waves in the heart muscle
Ultra Sound Scanner	to understand the structure of internal organs using ultrasonic sound waves
C T Scanner (Computed Tomography Scanner)	to get three-dimensional visuals of internal organs with the help of computer, using X-rays.
MRI Scanner (Magnetic Resonance Imaging Scanner)	to get three-dimensional visuals of internal organs.

MODEL QUESTIONS AND ANSWERS

1. Complete the table.

Equipment	Use
(a)	To understand the structure of internal organs using ultrasonic sound waves
(b)	To measure blood pressure
EEG	(c) .....
CT scanner	(d) .....
(e)	To know the heart beat
ECG	(f) .....

ANSWER KEY

1.

Equipment	Use
(a) Ultra sound scanner	To understand the structure of internal organs using ultrasonic sound waves
(b) Sphygmomanometer	To measure blood pressure
EEG	(c) To record electric waves in the brain .....
CT scanner	(d) To get three-dimensional visuals of internal organs with the help of computer using X-rays .....
(e) Stethoscope	To know the heart beat
ECG	(f) to record electric waves in the heart muscle .....

LABORATORY TESTS

Test details	Normal count
Haemoglobin	12 – 17 gm/ 100 ml of blood
Number of white blood cells	5000 – 10000 / ml of blood
Number of Red Blood Cells	45 lakhs to 60 lakhs / ml of blood
Number of Platelets	2.5 lakhs to 3.5 lakhs / ml of blood

- **VARIOUS AREAS OF SPECIALIZATION IN MODERN MEDICINE**

Specialization	Related Area
Cardiology	Treatment of heart
Ophthalmology	Treatment of eye
Neurology	Treatment of nervous system
Oncology	Treatment of cancer
E N T	Treatment of Ear, Nose, Throat

MODEL QUESTIONS AND ANSWERS

1. Various areas of specialization in modern medicine are given below. Choose the correct
pair.

(a) Ophthalmology - Treatment of ear
(b) Oncology - Treatment of cancer
(c) Cardiology - Treatment of nervous system

ANSWER KEY

1.
(b) Oncology – Treatment of cancer

MEDICINES

Medicines are either substances extracted from plants, animals or microorganisms or chemical substances synthesized in laboratories.

Antibiotics

- Medicines that are extracted from microorganisms like bacteria, fungi, etc. and **used to destroy bacteria** are called antibiotics.
- They can be used externally and internally.

Discovery of antibiotics

- **Alexander Flemming** discovered antibiotics in 1928. He accidentally discovered that the fungus ***Penicillium notatum*** has the ability to destroy bacteria.

Side effects of antibiotics

- regular use develops immunity in pathogens against antibiotics
- destroys useful bacteria in the body
- reduces the quantity of some vitamins in the body

Antiviral medicines

Used to control viruses

Antifungal medicines

Used to destroy fungi

MODEL QUESTIONS AND ANSWERS

1. Write correct explanation for the given statements.
(a) Do not use antibiotics without the recommendation of a doctor.

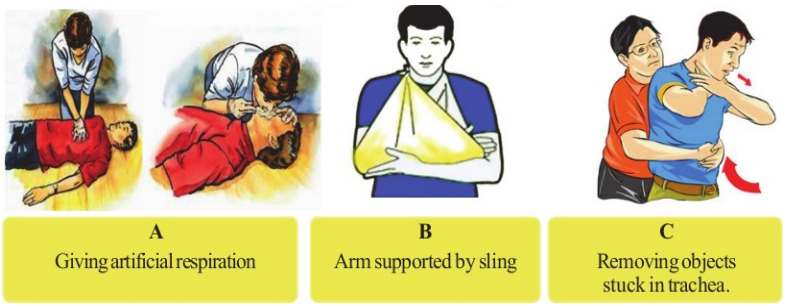
ANSWER KEY

(a) Regular use of antibiotics without the recommendation of a doctor may create many side effects.

- develops immunity in pathogens against antibiotics
- destroys useful bacteria in the body
- reduces the quantity of some vitamins in the body

FIRST AID

First aid refers to the emergency care or treatment given to an ill or injured person before regular medical aid can be obtained.



A
Giving artificial respiration

B
Arm supported by sling

C
Removing objects stuck in trachea.

BLOOD TRANSFUSION

Blood transfusion – Precautions

- People in the age group 18 – 60 can donate blood
- Blood donation can be done once in three months
- Blood donation causes no problem to the donor's health
- Pregnant women and breast feeding mothers should not donate blood
- Persons with communicable diseases (transmitted through blood) should not donate blood

Basis of blood group determination

- The basis of blood grouping is the presence of antigen A and antigen B in red blood cells.
- The blood group of a person is named according to the antigen present in that person's blood.

Antibodies and blood groups

- Antibodies are present in the blood plasma
- In blood group A, antibody b and in blood group B, antibody a are present.
- In blood transfusion, antibodies are of special importance.

Rh factor

Blood groups are classified as positive and negative based on the presence or absence of Antigen D or Rh factor present in the cell membrane of red blood cells.

The blood groups in which Antigen D or Rh factor is present are called positive blood groups and those without Rh factor are called negative blood groups.

Can a patient receive blood from any person. Why ?

No. When a foreign antigen reaches one's blood, it stimulates the defense mechanism. On receiving unmatching blood, the **antigen present in the donor's blood** and the **antibody present in the recipients blood** will **react** with each other and **form a blood clot**. Hence, everyone cannot receive blood from all blood groups.

Different types of blood groups

Blood groups	Antigen	Antibody
A^{+ve}	A, D	b
A^{-ve}	A	b
B^{+ve}	B, D	a
B^{-ve}	B	a
AB^{+ve}	A, B, D	Nil
AB^{-ve}	A, B	Nil
O^{+ve}	D	a, b
O^{-ve}	Nil	a, b

MODEL QUESTIONS AND ANSWERS

1. Manu who met with an accident ,was in need of blood. Antigen A and D and Antibody b was identified in his blood.
(a) Name his blood group.
(b) What is the basis of blood grouping ?
(c) Blood groups are classified as positive and negative. What is the basis of this ?

2. Write correct explanation for the given statements.
(a) Nobody can receive blood from all blood groups.

ANSWER KEY

(a) A +ve

(b) The basis of blood grouping is the presence of antigen A and antigen B in red blood cells.

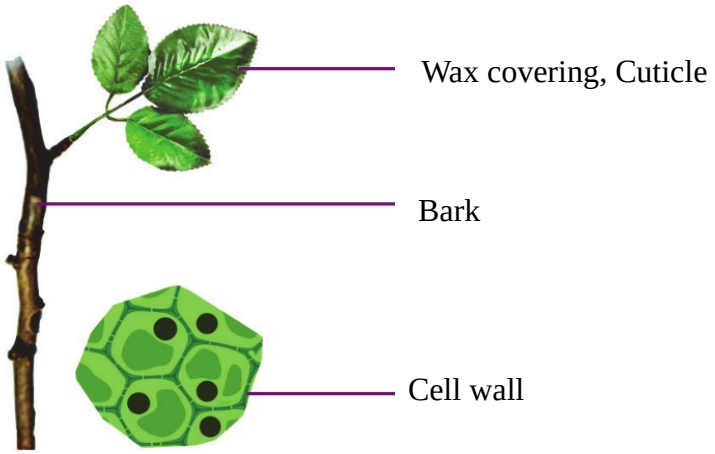
(c) Blood groups are classified as positive and negative based on the presence or absence of Antigen D or Rh factor present in the cell membrane of red blood cells.
The blood groups in which Antigen D or Rh factor is present are called positive blood groups and those without Rh factor are called negative blood groups.

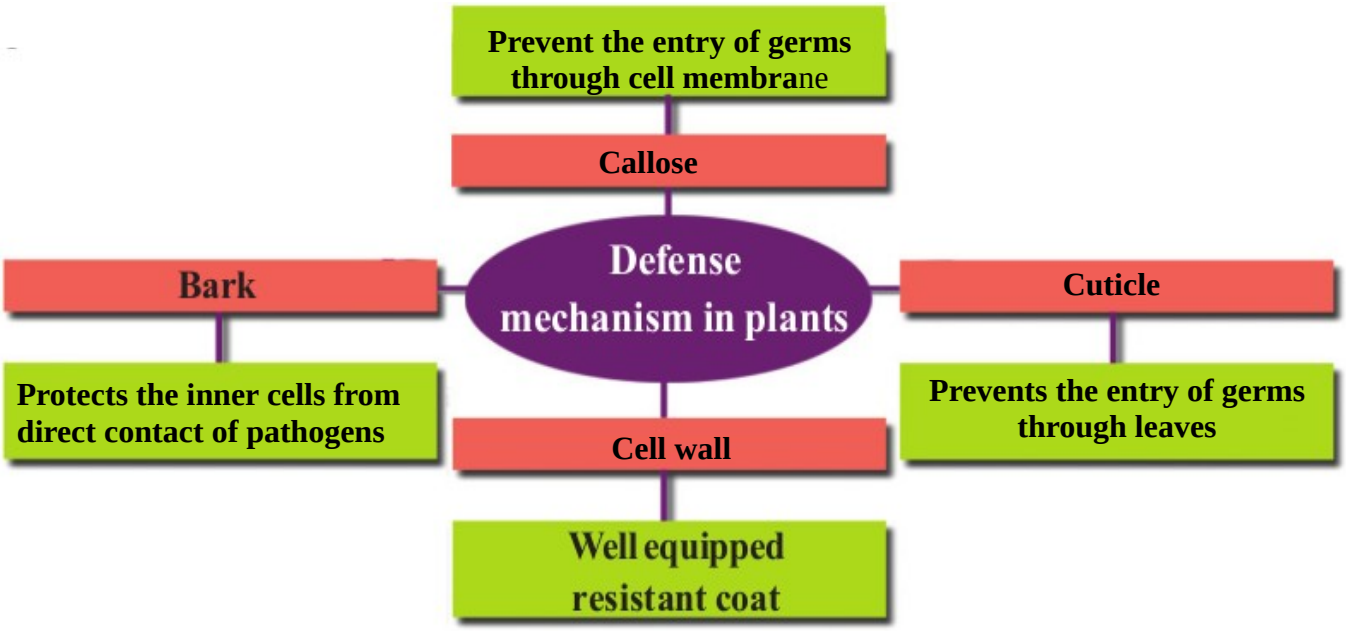
2. On receiving unmatching blood, the antigen present in the donor's blood and the antibody present in the recipients blood will react with each other and form a blood clot. Hence, everyone cannot receive blood from all blood groups.

DEFENSE MECHANISMS IN PLANTS

- Plants have mechanisms to prevent the entry of germs and to fight against those that have already entered.

- In plants, defense is made possible through structural and biochemical methods





Lignin, Cutin, Suberin

- chemical substances that provide rigidity to the cell wall.

Callose

- a polysaccharide formed in the cell wall
- the germs that have crossed the cell wall are prevented from entering through the cell membrane by callose

MODEL QUESTIONS AND ANSWERS

1. How does the cell wall help in the defense of diseases in plants ?

ANSWER KEY

1.

In plants, cell wall act as a well equipped resistant coat.

- Chemical substances lignin, cutin, suberin etc. provide rigidity to the cell wall.
- The germs that have crossed the cell wall are prevented from entering through the cell membrane by callose, a polysaccharide formed in the cell wall.

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