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INTRODUCTION TO IMMUNOLOGY & THE LYMPHOID SYSTEM

Color Index:

Main Text

Important

Female Slides

Male Slides

Dr's Notes

Extra

OBJECTIVES

01

To know the historical perspective of immunology

02

To be familiar with the basic terminology and definitions of immunology

03

To recognize immune response cells

04

To understand types of immune responses

05

To know about the lymphoid system

06

To understand T and B cell functions

A HISTORICAL PERSPECTIVE OF IMMUNOLOGY

WATCH VIDEO

Immunity:
is the state of protection against foreign pathogens or substances (antigens).

Word origin:
Latin term immunis, meaning “exempt”. is the source of the English word (immunity).

Observations of immunity go back over 2000 years, when Thucydides, an ancient historian, wrote in 430 BC of a plague in Athens where those who had recovered could safely nurse the currently ill (they have resistance/immunity) .

Can we generate immunity without inducing disease?

YES through vaccination

- Vaccination prepares the immune system to eradicate an infectious agent before it causes disease

- Widespread vaccine use has saved many lives
- Examples:

1. rabies vaccine
2. eradication of smallpox

CASES OF SELECTED INFECTIOUS DISEASE IN THE UNITED STATES BEFORE AND AFTER THE INTRODUCTION OF EFFECTIVE VACCINES

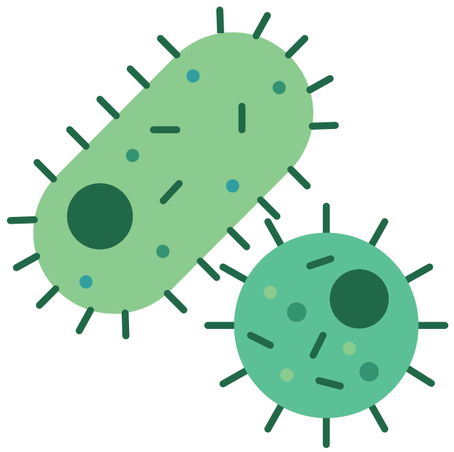
Disease	ANNUAL CASES/YR: Prevaccine	CASES IN 2016: Postvaccine	Reduction (%)
Smallpox	48,164	0	100
Diphtheria	175,885	0	100
Measles	503,282	79^	99.98
Mumps	152,209	145*	98.90
Pertussis ("whooping cough")	147,271	964*	99.35
Paralytic polio	16,316	0	100
Rubella (German measles)	47,745	0*	100
Tetanus ("lockjaw")	1,314 (deaths)	1* (case)	99.92
Invasive *Haemophilus influenzae*	20,000	356*	98.22

NOTE:
- The effectiveness of a vaccine can be measured by comparing the number of annual cases per year before and after vaccination.
- They tried vaccinations before even knowing the components of the immune system (442)

LOUIS PASTEUR'S CONTRIBUTIONS

DETERMINED

Determined that the virulence of a pathogen weakens with age

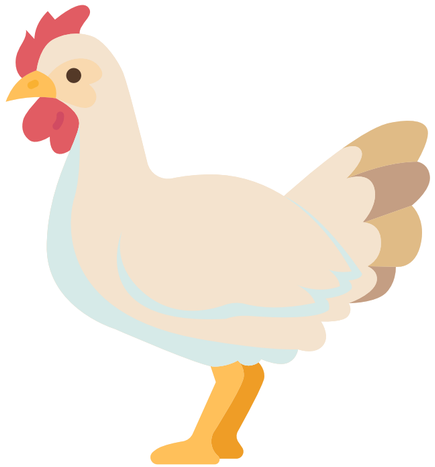


DISCOVERED

Discovered that Attenuated: weakened, non-virulent strain whose exposure can confer resistance to disease

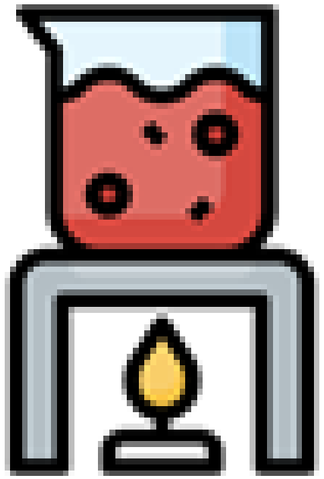
OBSERVED

Observed that chickens inoculated with old strains not only survive, but become resistant



CLASSICAL EXPERIMENT

Heat attenuated anthrax bacillus and subsequent challenge with virulent Bacillus anthracis in sheep



DEFINITIONS

ANTIGEN (AG)

(IT'S THE PART WHICH THE RECEPTOR OF T & B CELLS RECOGNIZE IT)

any substance (usually foreign) that **binds specifically** to a component of the adaptive immunity

ALLERGEN

noninfectious antigens that induce Allergy

INNATE IMMUNITY

Nonspecific host defenses that exist prior to exposure to Ag (immediate response against pathogen)

ADAPTIVE IMMUNITY

Specific host defenses that are mediated by T & B cells following exposure to Ag

PATHOGEN

a **disease causing** organism

VACCINATION

deliberate **induction** of **protective** immunity to a pathogen

IMMUNO-GLOBUULIN E (IG)

or Antibodies: it's molecules secreted from plasma cell (B cell) as an adaptive immune **response to extracellular Ag**

CLUSTER OF DIFFERENTI-ATION (CD)

molecule with a CD has a characteristic **cell surface protein** which are often associated with the cell's function

441:
-Markers are used to distinguish lymphocytes.
- Lymphoid series comprise of main lymphocyte populations

LYMPHOCYTE POPULATION

NATURAL KILLER CELL MARKER (NK)

CD16 & CD56 (BOTH)

T CELL MARKERS

CD4 IN T HELPER CELLS ONLY

CD3 IN ALL T CELL

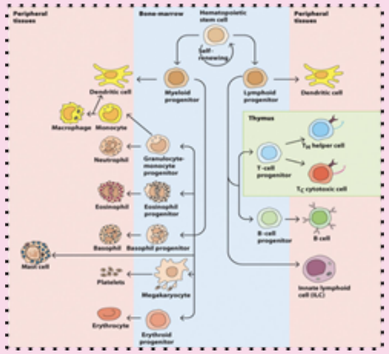
CD8 IN T CYTOTOXIC(CTL) CELLS ONLY

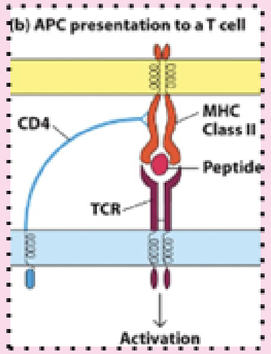
B CELL MARKERS

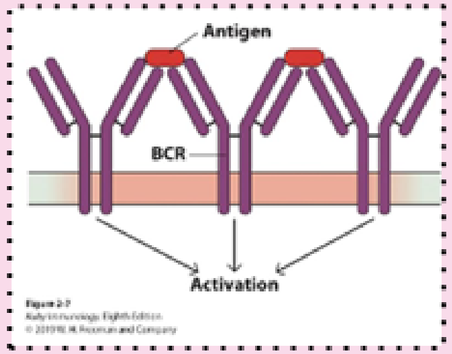
CD19

T helper :

T cytotoxic :







CELLS OF THE IMMUNE SYSTEM

B CELLS EXPRESS THE B CELL RECEPTOR (BCR)

T CELLS EXPRESS THE T CELL RECEPTOR (TCR)

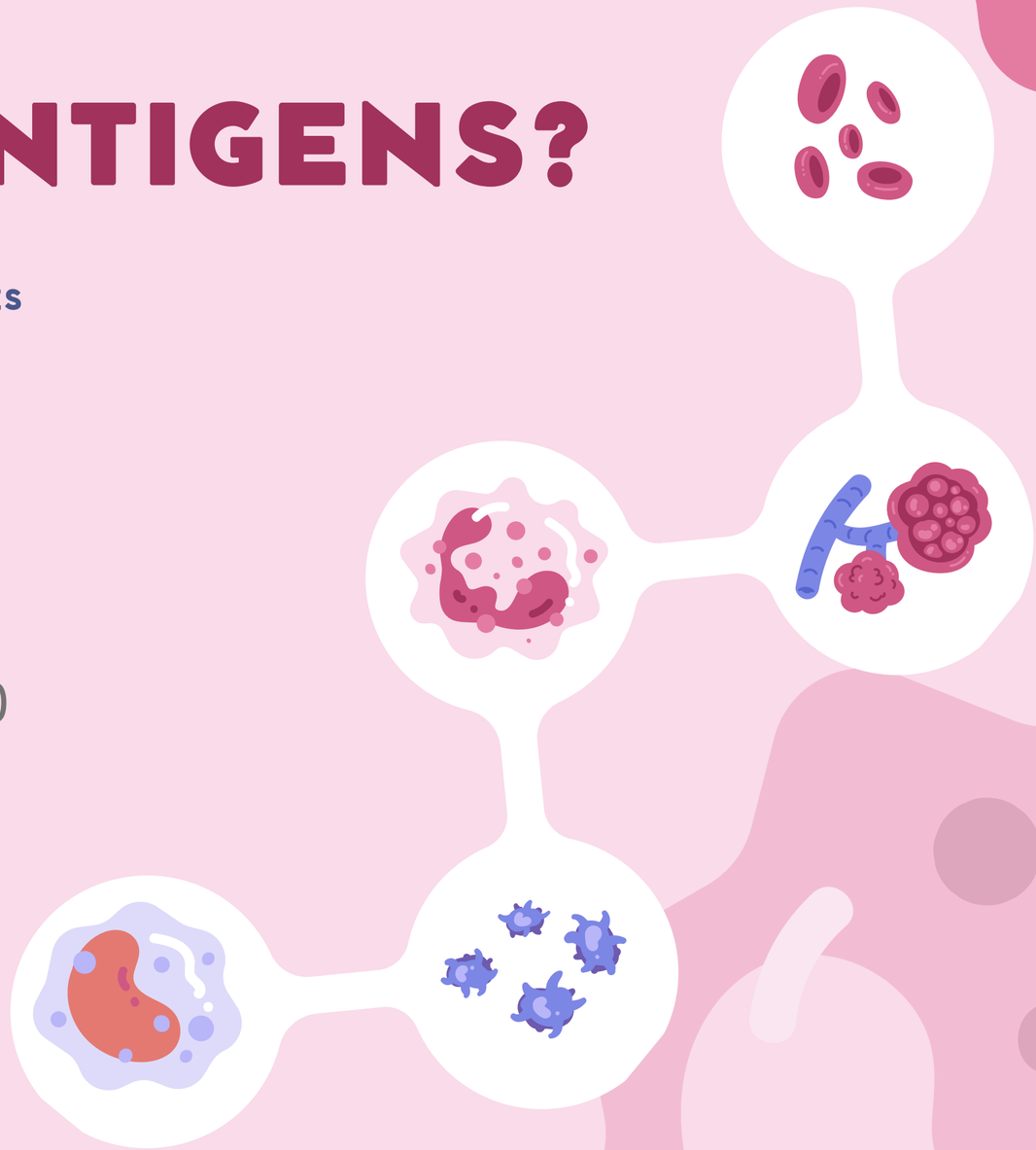
WHAT ARE ANTIGENS?

01 **Microorganisms & their related products**
(Proteins, polysaccharides, lipids)

02 **Environmental substances**
(Pollens, soil component)

03 **Drugs**
(Allergic reaction against certain drugs)

04 **Organs(organ transplant), tissues, cells**



438: There’s a difference between antigens and immunogens. Not all antigens induce an immune response. Antigens that induce an immune response are called immunogens. So all immunogens are antigens but not all antigens are immunogens.

TYPES OF IMMUNITY

WATCH VIDEO

INNATE (NATURAL) IMMUNITY

NONSPECIFIC HOST DEFENSES THAT EXIST PRIOR TO EXPOSURE TO ANTIGEN

◎ FIRST LINE OF DEFENSE

◎ FAST, BUT NONSPECIFIC

◎ ALSO USES PHAGOCYTIC CELLS

◎ SHORT DURATION (VERY FAST)

◎ NO MEMORY CELLS

439:FURTHER EXPLANATION:
1-ANTIBODIES ARE PRODUCED BY (B LYMPHOCYTES)
2-ANTIBODIES ARE FOUND IN BODY FLUID (BLOOD AND LYMPH)

ADAPTIVE (ACQUIRED) IMMUNITY

SPECIFIC HOST DEFENSES THAT ARE MEDIATED BY T AND B CELLS FOLLOWING EXPOSURE TO ANTIGEN

◎ RESPONSE OF SPECIFIC B AND T LYMPHOCYTES TO AN ANTIGEN

◎ EXHIBIT IMMUNOLOGICAL MEMORY

◎ SELF / NON-SELF RECOGNITION

◎ SLOWER TO DEVELOP (5-6 DAYS OR MORE)

439:RECOGNIZE WHETHER THE BODY (ANTIGEN) IS FROM INSIDE OR OUTSIDE THE BODY.
WHEN ANTIGEN IS FROM INSIDE THE BODY IT'S
CALLED: AUTOIMMUNE DISEASE

CELL MEDIATED IMMUNITY(CMI)

IMMUNE RESPONSE IN WHICH ANTIGEN SPECIFIC T CELLS DOMINATE

RESPONSE TAKES PLACE INSIDE THE CELL

HUMORAL IMMUNITY (ABMI)

IMMUNITY THAT IS MEDIATED BY ANTIBODIES(B CELLS)

RESPONSE TAKES PLACE IN BLOOD AND LYMPH

ABMI: ANTIBODY MEDIATED IMMUNITY,HUMORAL=FLUID

INNATE AND ADAPTIVE IMMUNITY WORK COOPERATIVELY BY ACTIVATION OF INNATE IMMUNE RESPONSES PRODUCES SIGNAL FIRST MOLECULES (CYTOKINES) THAT STIMULATE AND DIRECT ADAPTIVE IMMUNE RESPONSES

LYMPHOID SYSTEM

Lymphatic vessels

lymphoid organs

Secondary Lymphoid Organs
(where the immune response occurs)

- Peyer's patches
- Appendix
- Tonsils
- Lymph nodes
- Spleen
- MALT
  (Mucosa Associated Lymphoid Tissue)

Primary Lymphoid Organs
(Development & Differentiation of immune cells)

- Bone marrow
- Thymus

SECONDARY LYMPHOID ORGANS

01

Lymph nodes and spleen are the most highly organized secondary lymphoid organs

02

Differentiation into effector cells takes place in follicles of secondary lymphoid organs

03

Both B and T lymphocytes will develop into long-lived memory cells in these areas

04

The spleen is the first line of defense against blood-borne pathogens

05

Mucosa-associated lymphoid tissue (MALT) Important layer of defense against infection at mucosal and epithelial layers.

T-LYMPHOCYTE DIFFERENTIATION

01

ORIGIN : BONE MARROW

02

MIGRATE TO THYMUS

All of them have CD3 proteins on their cell surface

03

DIFFERENTIATION

During their passage through thymus they differentiate into T cells expressing either markers (CD4 T helper cell or CD8 T cytotoxic cell)
ALL of T cells have CD3 protein on their surface.

T-LYMPHOCYTE

T Helper lymphocytes (CD4+)

Th1

Inflammatory T helper cell
Mediates inflammation by helping macrophages inCMI during inflammatory response
Also helps CD8+ cells to become activated cytotoxic T cells.

Th2

Provides help to B cell to produce antibody

Th17

Has a role in innate Immunity & the pathogenesis of autoimmune diseases.

Th(reg)

Repress the growth and function of T cell helper and cytotoxic subsets (regulatory T cells)

Tfh

T follicular helper are critical to prevent autoimmunity.

T Cytotoxic (CD8+) Cells

- About 35% of peripheral blood T cells
- Perform cytotoxic functions
- They mediate the killing of:

-Virus-infected cells
-Tumors
-and Allograft cells (transplant)

B-CELLS

Origin

- During embryogenesis – fetal liver (before birth)
- Migrate to bone marrow – final destination (after birth)
- They do not require thymus for maturation

B cell progenitors

Pro-B cells, Pre-B cells and immature B cells are normally found in bone marrow

Mature B cells

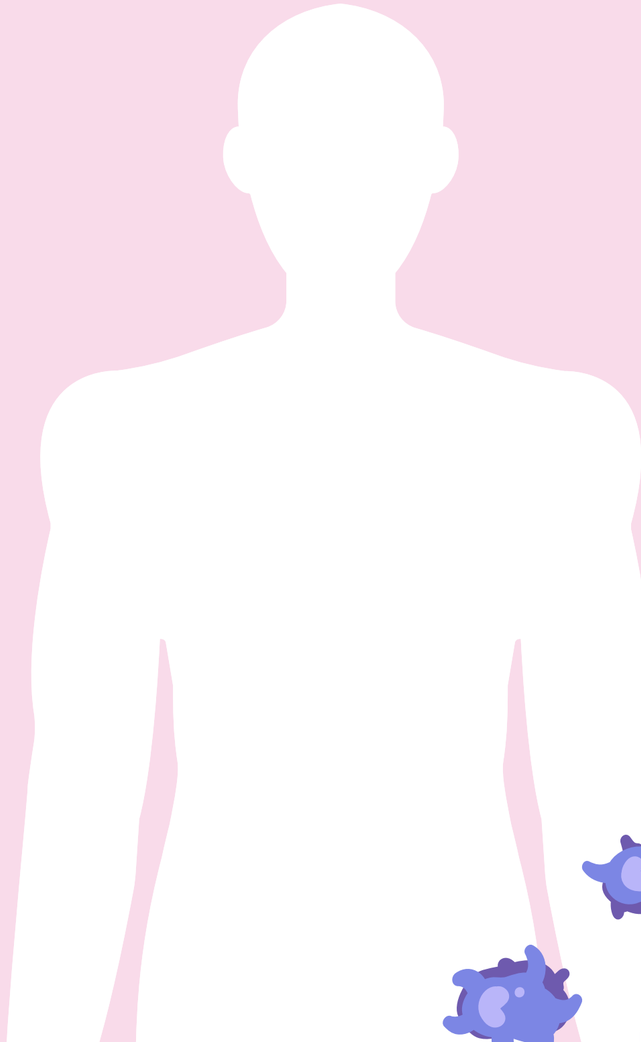
- Mature B cells are found circulating in body fluids (blood, lymphatic fluid) and lymphoid organs
  - IgM (immunoglobulin M)
  - IgD (immunoglobulin D)

which serve as antigen receptors (Maturation Markers)

THE GOOD, BAD, AND UGLY OF THE IMMUNE SYSTEM

The Role of Immune system is to PROTECT
Dysfunction of this role when it is Abnormal:

- Overly active: Hypersensitivity / Autoimmunity
- Defects in the immune response:Immunodeficiency
- Rejection of transplanted tissue or organ
- Cancer

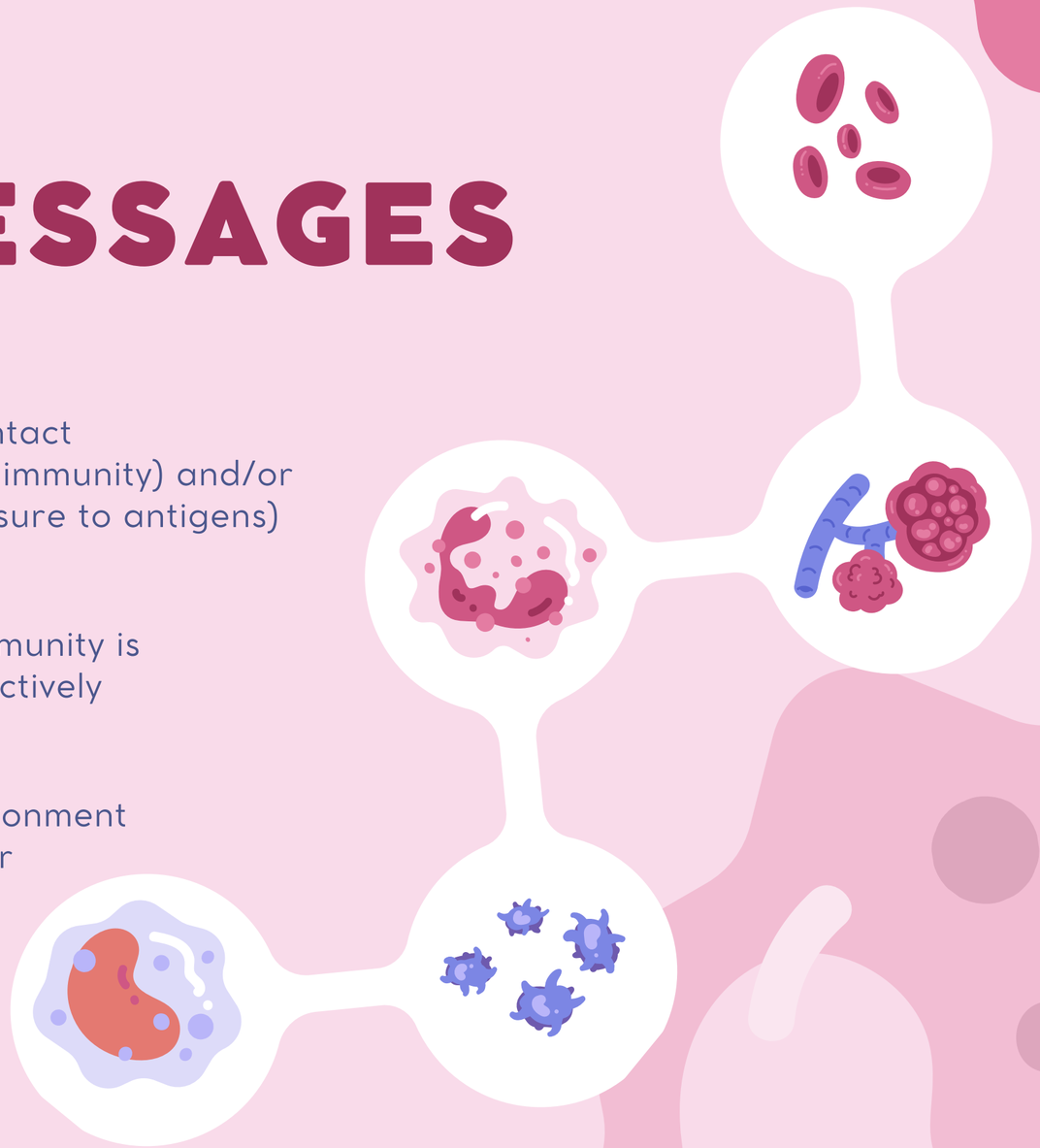


TAKE HOME MESSAGES

01 Normal healthy state is maintained by intact immune response either innate (natural immunity) and/or adaptive (acquired immunity after exposure to antigens)

02 Cell mediated immunity and humoral immunity is mediated by T and B lymphocytes respectively

03 Lymphoid system provides suitable environment for development, maturation and proper functioning of cells of immune system



MCQ'S

ANSWERS:
1-C 2-D 3-B 4-C

1 WHERE CAN WE FIND IMMATURE B CELLS?

A	Thymus	B	Fetal liver	C	Bone marrow	D	Body fluid

2 T HELPER CELLS HAVE ON ITS SURFACE:

A	CD19	B	CD8	C	CD16 & CD56	D	CD3 & CD4

3 THE VIRULENCE OF PATHOGEN _____ WITH AGE:

A	Increases	B	Decreases	C	Stable	D	No relationship

4 SPECIFIC HOST DEFENSES THAT ARE MEDIATED BY T & B CELLS FOLLOWING EXPOSURE TO AG:

A	Immunoglobuline	B	Pathogen	C	Adaptive immunity	D	B cell markers

MCQ'S

ANSWERS:

5-B 6-B 7-D 8-A

5 WHICH OF THE FOLLOWING IS A PRIMARY LYMPHOID ORGANS?

A	Spleen	B	Thymus	C	lymph node	D	Appendix

6 WHICH OF THE FOLLOWING HELPS B CELLS TO PRODUCE ANTIBODIES?

A	Th1	B	Th2	C	Th17	D	Th(reg)

7 WHICH OF THE T HELPER LYMPHOCYTES IS CRITICAL TO PREVENT AUTOIMMUNITY?

A	Th1	B	Th2	C	Th17	D	Tfh

8 THE FIRST LINE OF DEFENCE AGAINST BLOOD-BORNE PATHOGENS IS:

A	spleen	B	Thymus	C	Lymph node	D	liver

MEET THE TEAM

LEADERS

Abdullah Alzoom

Sadeem Alsaadoon

MEMBERS

Abdulhadi Alqahatani

Bandar Alzaaidi

Faisal Alaowairdhi

Homoud Alsuhali

Omar Alattas

Ziyad Bukhari

Alanoud Alnajawi

Basmah Alghamdi

Lama Alhayan

Manar Alqahtani

Shahad Alzenaidy

Shaden Alotaibi

Contact us on immunology.444ksu@gmail.com