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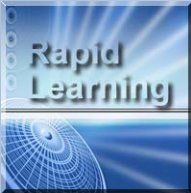


Rapid Learning Center Presenting ...

**Teach Yourself**  
**Immunology** in 24 Hours



<http://www.RapidLearningCenter.com>




**Introduction to  
Immunology**

**Rapid Learning Tutorial Series**

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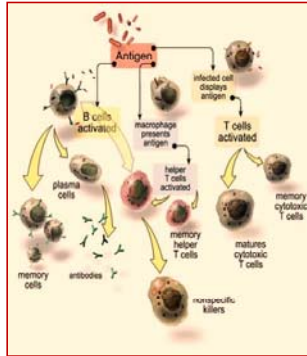
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## Learning Objectives

After completing this tutorial, you will learn about:



- Immunology and its scope
- Basic concepts in Immunology
- History of Immunology
- What the Immune System is
- Cells and organs of the Immune system

3/38

Disclaimer: All educational materials in this course are not intended for medical advices. Consult your medical doctors for advices and treatments.



## Introduction - Topics

- What is Immunology?
- Immune System
- Immunity
- Scope of Immunology



4/38





## What is Immunology?

- The **environment** in which we live contains an incredible variety of infectious agents, such as bacteria, viruses, fungi, protozoa, and multi-cellular parasites and their products.
- If they **multiply** unchecked, they will wreak havoc on our body's function.
- To fight against these constant threats, we need to have a **protective** system. Otherwise, we would easily succumb to diseases caused by these pathogens and toxins produced by them.
- It is the **immune system** that keeps us healthy.



5/38



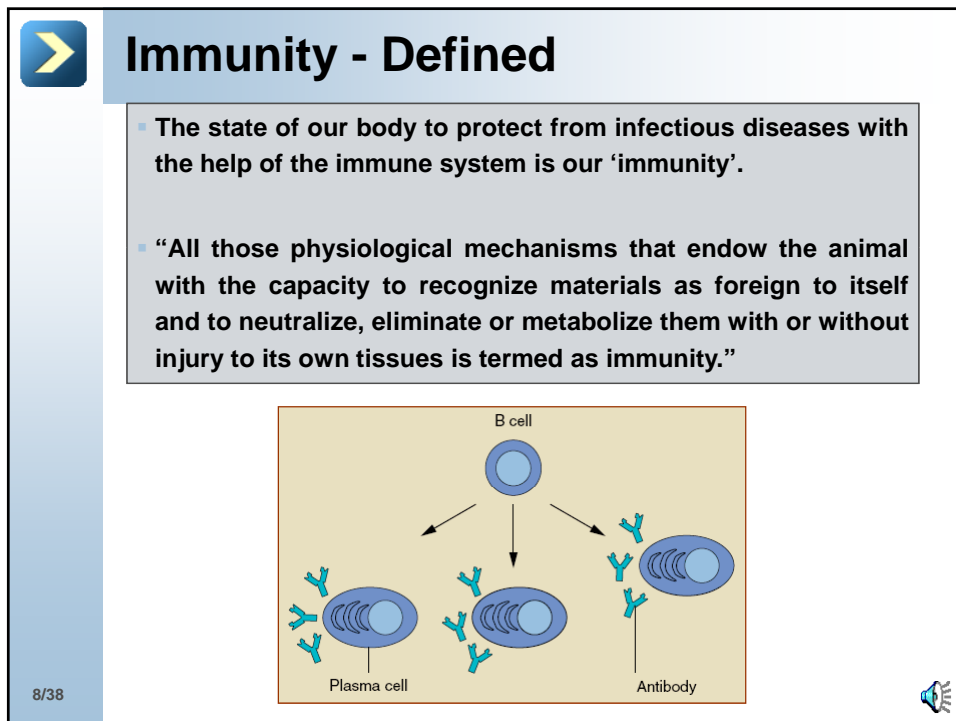
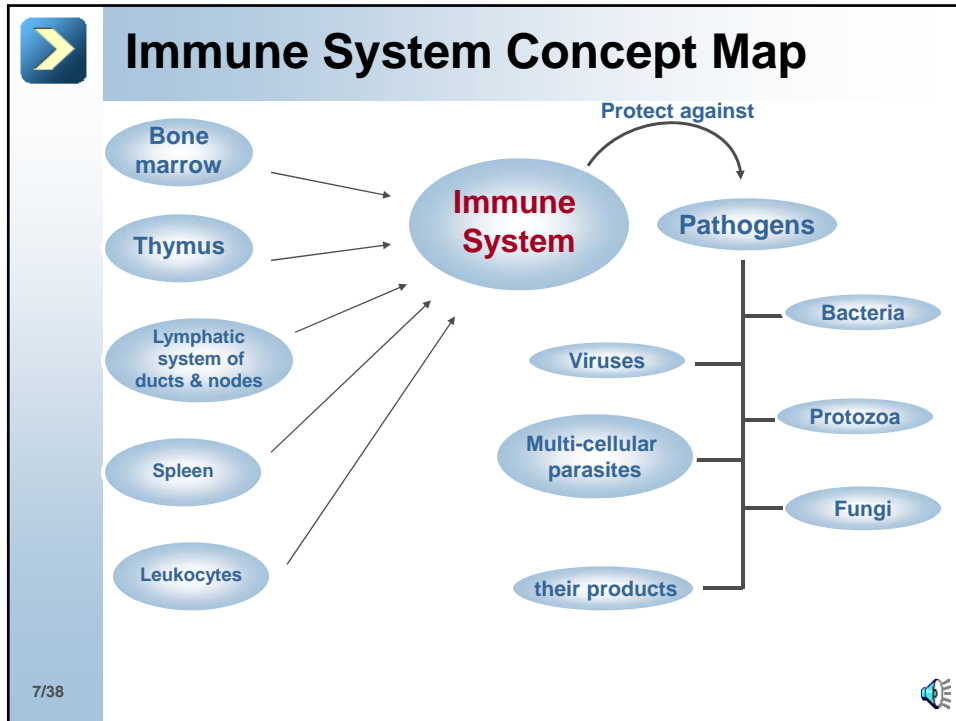
## Immune System

- It is a unique **adaptive defensive system** that has evolved in vertebrates. It recognizes and destroys foreign substances and organisms that enter the body.
- The immune system can distinguish between the body's own tissues and outside substances called **antigens**. It is specific against foreign antigens.
- The ability to identify an antigen also permits the immune system to "**remember**" antigens so that the body can mount a better and faster immune response the next time any of these antigens appear.




6/38









## Basic Concepts in Immunology



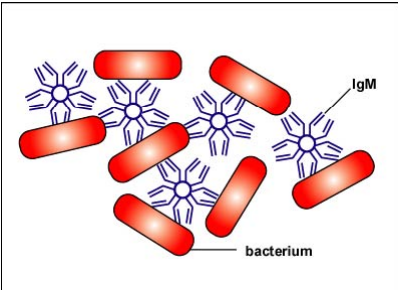
1. Humoral and Cellular Immune Response
2. Innate and Acquired Immunity
3. Antigen and Antibody
4. Cells and Organs of the Immune System


9/38 



## Basic Concepts in Immunology

- The primary function of our immune system is to **eliminate infectious agents** and to **minimize the damage** they can cause.
- In the first instance, the exterior defense of the body presents an effective barrier to most organisms, and very few infectious agents can penetrate the intact skin.

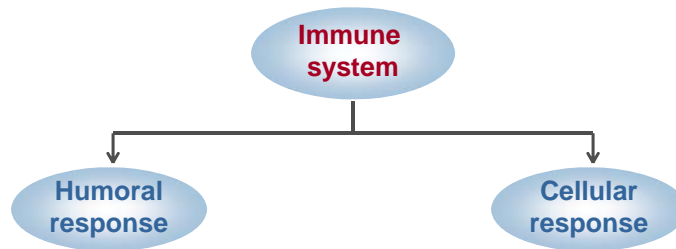


10/38 



## Humoral and Cellular Immunity - 1

- The immune system comprises of two parallel, but interrelated, systems: **The Humoral immune response** and **Cellular immune response**.

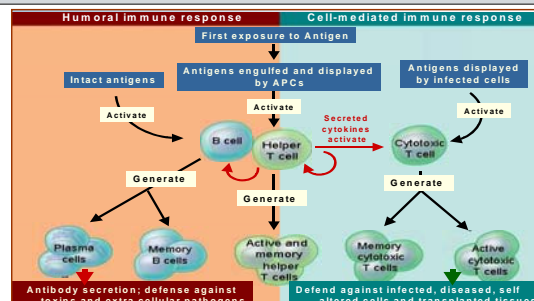


11/38



## Humoral and Cellular Immunity - 2

- In the humoral immune response, soluble proteins called **antibodies** (immunoglobulins) function as recognition elements and they bind specifically to antigens. Antibodies are secreted by plasma cells that are derived from B-lymphocytes (B cells).
- In the cellular immune response, cells called **cytotoxic T-lymphocytes** kill cells that display foreign motifs on their surfaces. The cellular immune response is mediated by specific receptors that are expressed on the surface of the T cells.



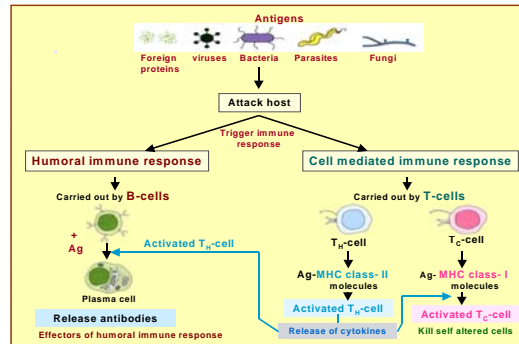
12/38





## Humoral and Cellular Immunity - 3

- Another class, called **helper T-lymphocytes**, contribute to both humoral and cellular immune responses by stimulating the differentiation and proliferation of appropriate B cells and T cells.
- The site of **infection** and type of **pathogen** largely determine which immune response will be effective.



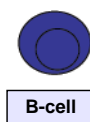
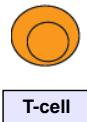
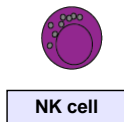
13/38



## Cells and Organs of the Immune System

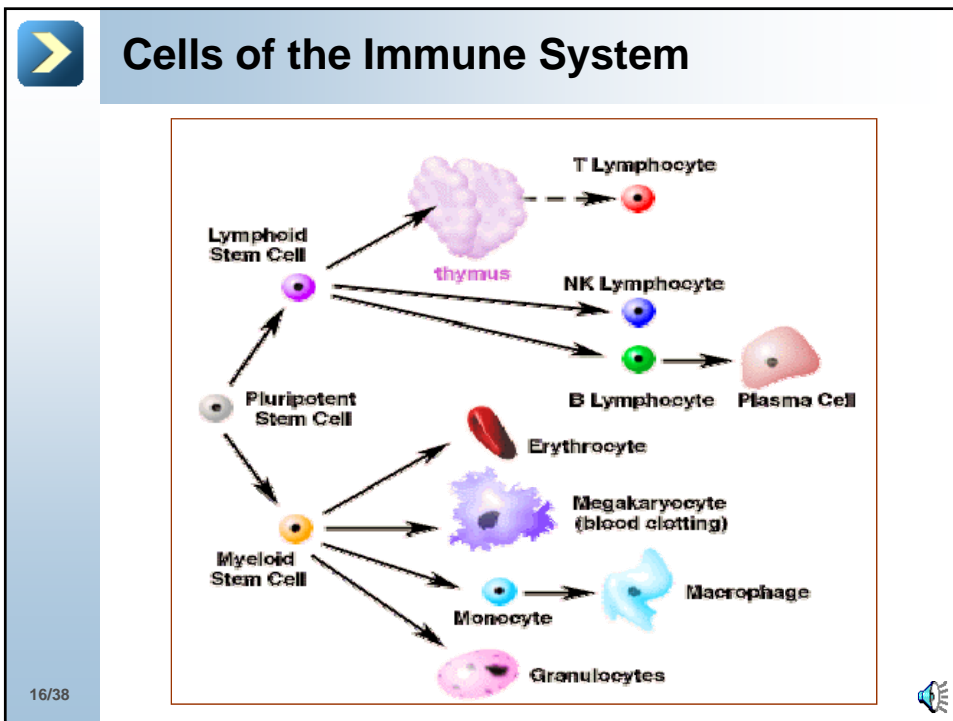
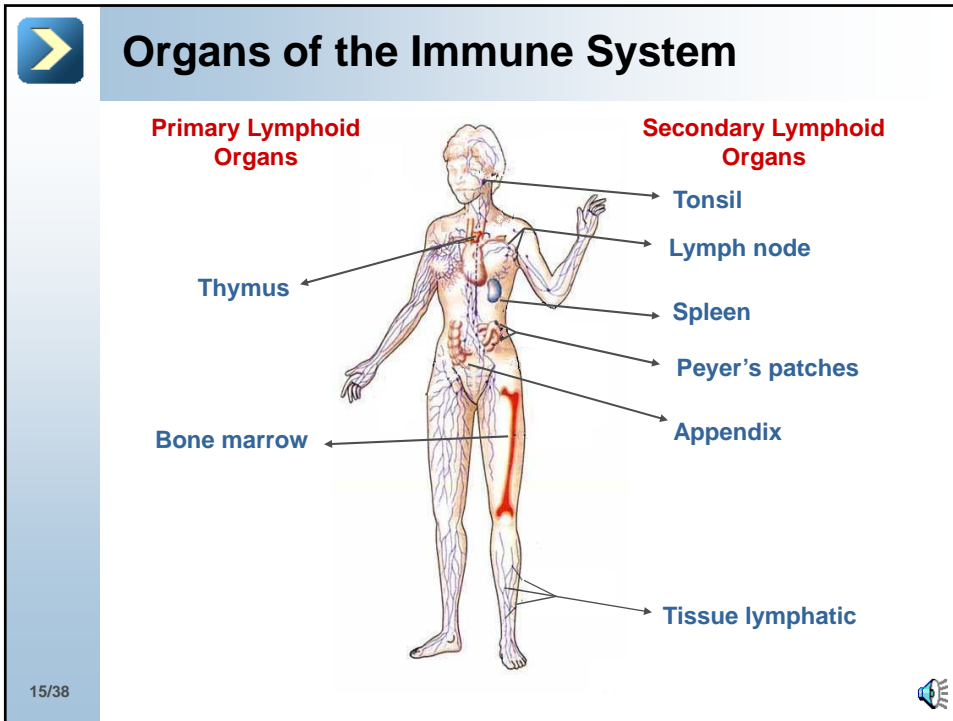
-  Neutrophil
-  Basophil
-  Eosinophil
-  Monocyte
-  Macrophage

- Immune responses are mediated by a variety of cells and by the soluble molecules that they secrete. **Leukocytes** (WBCs) are central to all immune responses. Other cells in the tissues, such as macrophages and cytokines liberated by **lymphocytes**, also contribute to the immune response.
- A number of morphologically and functionally diverse organs and tissues function in the development of immune responses.
- These can be divided as **Primary Lymphoid Organs** and **Secondary Lymphoid Organs**.



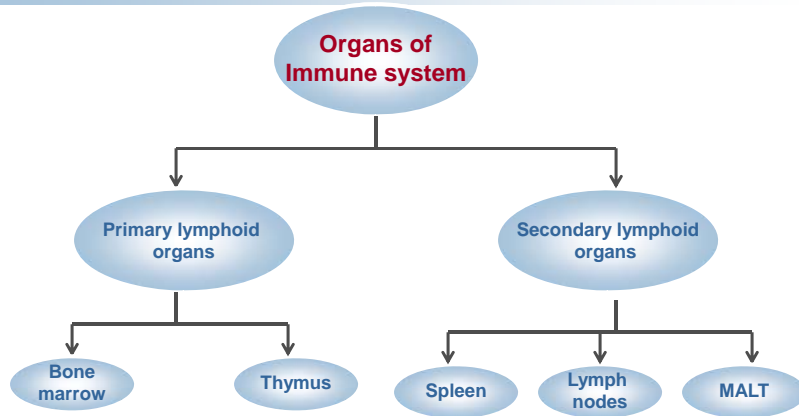
14/38







## Cells and Organs of the Immune System



**MALT** = mucosal associated lymphoid tissue

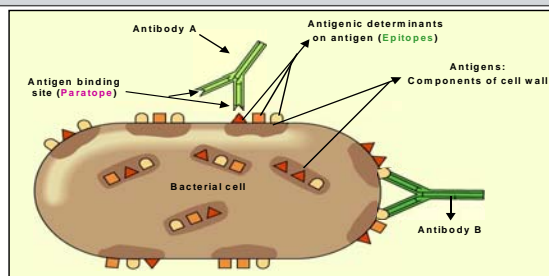
17/38



## Antigen

### What is an Antigen?

- Any substance (usually foreign) that binds specifically to an **antibody**, or a **T cell receptor**, is referred to as an 'antigen'.
- A substance capable of inducing a specific immune response is called an antigen.
- **Immunogenicity** and **antigenicity** are the two attributes of the antigen.



18/38

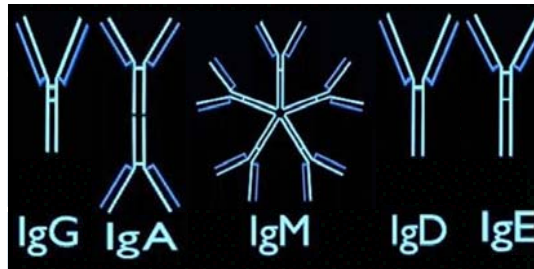




## Antibody

### What is an Antibody?

- A protein (immunoglobulin) that recognizes a particular antigen and binds specifically to it is called an '**antibody**'.
- Antibodies are produced by B cells. There are five classes of antibodies, namely IgG, IgA, IgM, IgD, IgE.

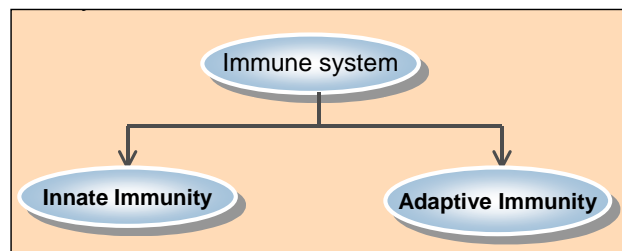


19/38



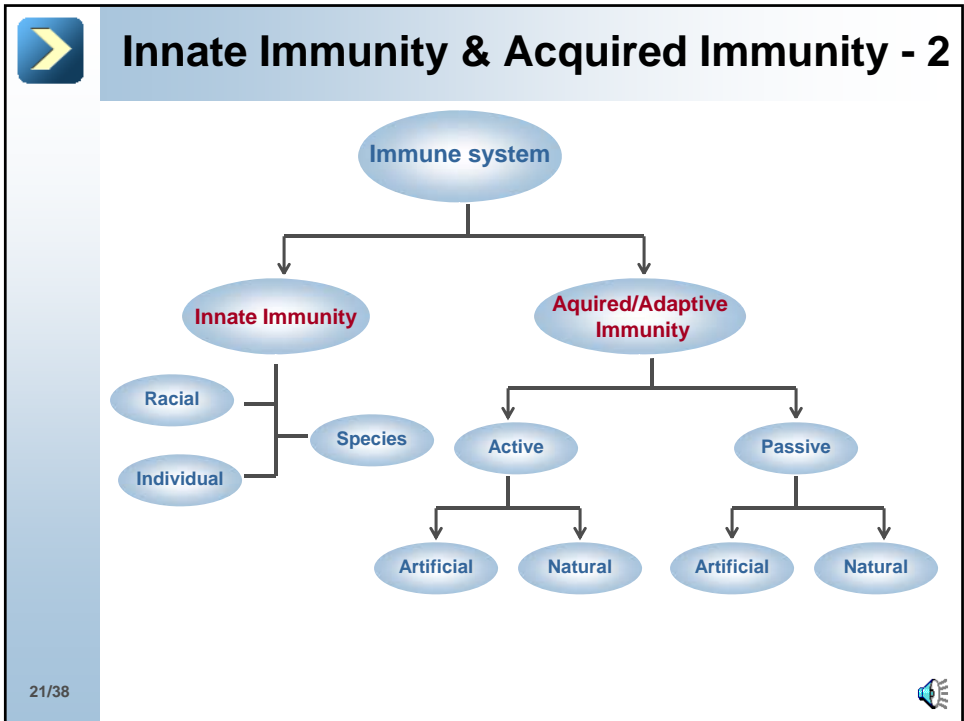
## Innate Immunity & Acquired Immunity - 1

The Immune system is comprised of two parallel, but interrelated, systems that work in harmony with each other, making them both more effective. These are **Innate Immunity** and **Acquired/Adaptive immunity**.



20/38





## ➤ Innate Immunity or Naive Immunity

- **Naive immunity** is the resistance to infections that an individual possesses by virtue of his genetic and constitutional make-up. It is not affected by prior contact with microorganisms or immunization.

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graph TD
    II([Innate Immunity]) --> I([Individual])
    II --> R([Racial])
    II --> S([Species])
    
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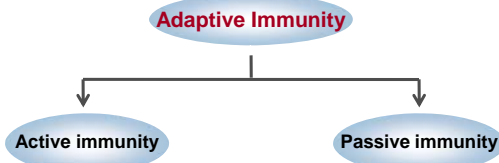
- **Innate immune responses** (non-specific) include anatomic, physiologic, endocytic and phagocytic with inflammatory barriers, which help prevent the entrance and establishment of infectious agents. It may be non-specific when it indicates a degree of resistance to infections in general or specifically when resistance to a particular pathogen is concerned. Innate immunity may be considered at the level of the species, race or individual.

22/38



## Adaptive/Acquired Immunity

- The **adaptive immunity** is the resistance that an individual acquires during life, different from the inborn innate immunity. Adaptive immune responses exhibit four immunological attributes: Specificity, Diversity, Memory, Self and Non-self recognition.
- **Antigen presenting cells, B-lymphocytes and T-lymphocytes** are the primary cells of the adaptive immune responses.
- Adaptive immune responses require some time to set in. Innate immunity provides the first line of defense during the critical period, just after the host's exposure to a pathogen.
- Acquired immunity can be one of two types, **active or passive**.

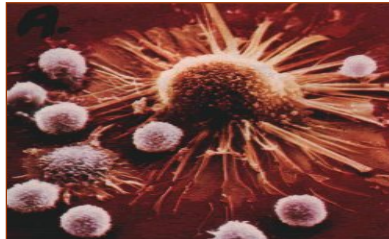


23/38



## Active Immunity or Passive Immunity

- **Active immunity** is the resistance developed by an individual, as a result of an antigenic stimulus. This involves the active functioning of a person's immune system, leading to the synthesis of antibodies and/or the production of immunologically active cells. Active immunity sets in only after a latent period, which is required for the immunological machinery to be set in motion.
- The resistance that is transferred to a recipient in a ready-made form is known as **passive immunity**. Here, the recipient's immune system plays no active role. There is no antigenic stimulus. Instead, pre-formed antibodies are administered.



24/38





# History of Immunology

25/38



## History of Immunology - 1


430 BC  
Thucydides  
Great Historian of  
Peloponnesian war

During the epidemic of plague, he observed that those who recovered from the plague would nurse the sick because they would not contract the disease a second time.

15th century  
Chinese & Turks

They developed the technique of Variolation.  
Dried crust developed from small pox pustules were either inhaled into the nostrils or inserted into the small cuts in the skin.  
Subjects developed immunity against small pox.  
Effects of the technique were confirmed by Lady Mary Wortley Montagu in 1718.

26/38





## History of Immunology - 2

1798  
Edward Jenner  
English physician



He improved the technique of Variolation and introduced the term 'Vaccination' to the world.

He observed that milkmaids who had contracted cowpox were subsequently immune to small pox.

He inoculated an eight year old boy with the fluid from a cow pox pustule; the boy did not develop small pox.

(A breakthrough finding in the field of immunology)

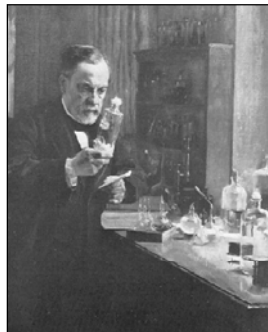
Jenner is known as the "Father of Vaccine".

27/38



## History of Immunology - 3

1880s  
Louis Pasteur



He devised a vaccine against cholera in chickens. He injected chickens with the old culture of bacterium, causing cholera. The chickens became ill, but recovered from the illness. After some days, he injected the fresh culture of the same bacterium in the same chickens. The chickens survived and were completely protected from the diseases. He recognized that aging the bacteria had weakened the virulence of the pathogen and the old strain has been 'attenuated'.

**Pasteur stated that "An attenuated strain might be administered to protect against the diseases."**

**He called this attenuated strain a 'vaccine'. He extended the findings to other diseases also.**

He developed a vaccine for anthrax. In a now-called classic experiment, at Pouilly-le-Fort in 1881, he vaccinated one group of shipmates with heat attenuated anthrax bacillus.

All the vaccinated shipmates survived and the unvaccinated shipmates died. These experiments marked the beginnings of the discipline of immunology.

In 1885, Pasteur administered the first vaccine to a human, which was a young boy named Joseph Meister who had been bitten by a rabid dog.

These practical triumphs led to a search for the mechanism of protection and to the development of the science of Immunology.

28/38



## ➤ History of Immunology - 4

1880s  
Robert Koch

↓

1880s  
Elie Metchnikoff

**He discovered the cause and nature of TB. He identified a microorganism, cultured the microorganism out of the body and injected it into an animal. The animal then got the disease. He earned the Nobel prize in 1905 for Cellular immunity to TB.**

**He is called the “Father of Cellular Immunology”. He observed starfish larvae under the microscope and saw that cells seemed to be engulfing each other. He stabbed the larvae with a rose thorn and saw that these engulfing cells then migrated towards the rose thorn, attacked and ingested it. The experiment led to the discovery of the mechanism ‘Phagocytosis’. It deduced the role of Phagocytosis in immunity and led to the concept of cell-mediated immunity. He earned the Nobel prize in 1908 with Paul Ehrlich.**

29/38

## ➤ History of Immunology - 5

1890  
Emil von Behring and Shibasaburo Kitasato

↓

1890s  
Paul Ehrlich

**They gave the first insights into the mechanism of immunity. Serum from animals, previously immunized to diphtheria, could transfer the immune state to unimmunized animals. They discovered that the serum of vaccinated individuals contained substances, which they called ‘antibodies’ that specifically bound to the relevant pathogen. Von Behring earned the Nobel Prize in medicine in 1901 for serum antitoxins.**

**He formulated what an antibody is and described how the immune system developed. He proposed a “lock and key” of antigen-antibody binding.**

30/38

## ➤ Nobel Laureates in Immunology - 1

1901  
Emil von Behring  
Serum antitoxins

1905  
Robert Koch  
Cellular immunity to tuberculosis

1908  
Elie Metchnikoff & Paul Ehrlich  
Role of Phagocytosis (Metchnikoff) and antitoxins (Ehrlich)

1913  
Charles Richet  
Anaphylaxis

31/38

## ➤ Nobel Laureates in Immunology - 2

1919  
Jules Bordet  
Discovery of complement-mediated bacteriolysis

1930  
Karl Landsteiner  
Discovery of human blood groups

1951  
Max Theiler  
Development of yellow fever vaccine


1957  
Daniel Bovet  
Discovery of antihistamines

32/38

## ➤ Nobel Laureates in Immunology - 3


1960  
F. Macfarlane Burnet  
& Peter Medawar  
Discovery of  
acquired  
immunological  
tolerance

1972  
Rodney R. Porter &  
Gerald M. Edelman  
Solved the chemical  
structure of  
antibodies



1977  
Rosalyn R. Yalow  
Development of  
radioimmunoassay


1980  
George Snell, Jean  
Dausset & Baruj  
Benacerraf  
Discovery of major  
histocompatibility  
complex

33/38 

## ➤ Nobel Laureates in Immunology - 4


1984  
Cesar Milstein  
Georges F. Kohler  
Niels K. Jerne  
Discovered  
monoclonal antibody  
immunotherapy.

1987  
Susumu Tonegawa  
Discovered gene  
rearrangement in  
antibody production



1991  
E. Donmall Thomas  
Joseph Murray  
Transplantation  
immunology

1996  
Peter C. Doherty  
Rolf M. Zinkernagel  
Proved the specificity  
of cell-mediated  
immune response

34/38 

## Questions: Review

Who is known as the 'Father of Vaccine'? ▶ Edward Jenner

Specificity, Diversity, Memory, Self & Non-self recognition - these are the four attributes of ▶ Adaptive immunity

Which Scientist is known as the "Father of Cellular Immunology"? ▶ Elie Metchnikoff

'Vaccination' is a type of: ▶ Active Immunity

Who got the Nobel Prize in 1930 for the discovery of human blood groups? ▶ Karl Landsteiner

35/38

## Learning Summary

**Innate immunity** is non-specific and depends on genetic and constitutional make-up. Acquired immunity exhibits attributes like Specificity, Diversity, Memory, Self and Non-self recognition and is acquired during life.

**Immunology** is the science that deals with the study of the body's protective mechanism against pathogens.

The **history of Immunology** can be traced back to 430 BC. 16 Nobel Prizes have been earned in this area of science.

The immune system consists of **Humoral** and **Cellular** immune response, which function in co-ordination to fight against diseases.

A number of morphologically and functionally diverse cells, organs and tissues function in the development of immune responses.



36/38

**Congratulations**

You have successfully completed  
the core tutorial

**Introduction to Immunology**

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**What's Next ...**

Step 1: Concepts – Core Tutorial (Just Completed)

→ Step 2: Practice – Interactive Problem Drill

Step 3: Recap – Super Review Cheat Sheet

**Go for it!**



38/38 <http://www.RapidLearningCenter.com>