

**IMM250H:**

Winter 2022

**The Immune System  
and Infectious Disease**

Week 1



TABLE OF CONTENTS

**OVERVIEW OF IMMUNE SYSTEM ..... 1**

**HISTORY OF IMMUNOLOGY ..... 1**

**SMALLPOX ..... 1**

**GERM THEORY OF DISEASE ..... 2**

**MODERN IMMUNOLOGY ..... 3**

**GENERATION OF IMMUNE CELLS..... 5**

## OVERVIEW OF IMMUNE SYSTEM

The immune system is a system of tissues, cells and soluble products that recognize, attack and destroy foreign entities that can endanger our health when they enter our bodies.

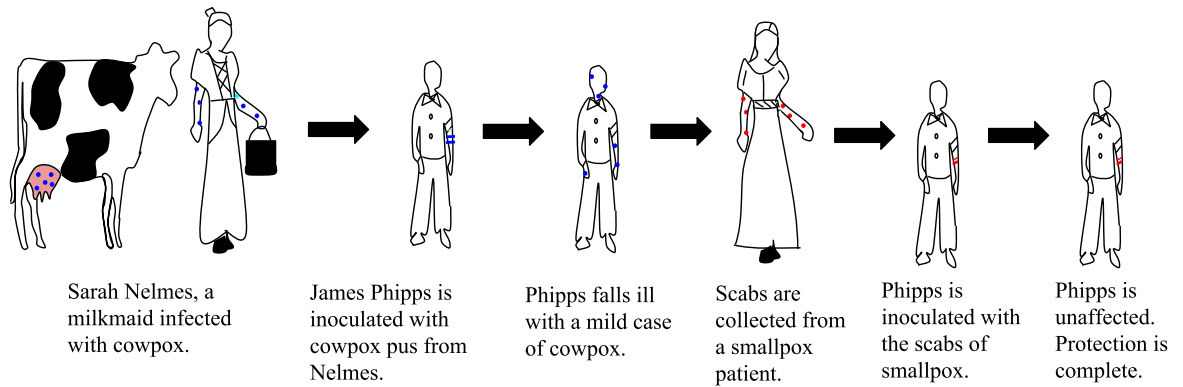
- Stage of immune response:
  - i. Recognition of invaded pathogens.
  - ii. Immune response.
    - Innate immunity.
    - Adaptive immunity.
  - iii. Return to resting states.
- Three lines of defense
  - i. Physical & chemical barriers
  - ii. Innate immunity → **Rapid but non-specific.**
  - iii. Adaptive immunity → **Slower but very specific and long-lasting.**

## HISTORY OF IMMUNOLOGY

### SMALLPOX

1. Infection
  - a. Caused by *Variola major*, a human virus with no animal reservoir.
  - b. Causes eruption of small fluid-filled vesicles on the skin (pocks), death, extensive scarring and blindness in survivors.
2. Significance
  - a. Smallpox helped European colonist to conquer American.
  - b. Smallpox is the first and the only human infectious disease that has been eradicated.
3. Variolation
  - a. Inoculation of someone with material from a smallpox pustule to produce immunity.
  - b. In 1721, Lady Mary Wortley oversaw a trial using prisoners and orphans who contracted a mild illness but survived.
  - c. Variolation was still hazardous, which led to spread of disease and even death.
4. **Edward Jenner**
  - a. Hypothesis: **Immunity to cowpox may also be effective against smallpox.**
    - i. Milkmaid often did not contract smallpox.
    - ii. They were exposed to cowpox during work.
    - iii. Cowpox is related to smallpox but less virulent.
  - b. Experiment in 1796
    - i. He inoculated a young boy James with the pus from the cowpox blisters of the milkmaid.
    - ii. The boy developed a mild fever.

iii. The boy was exposed to smallpox variolation and he did not develop symptoms.



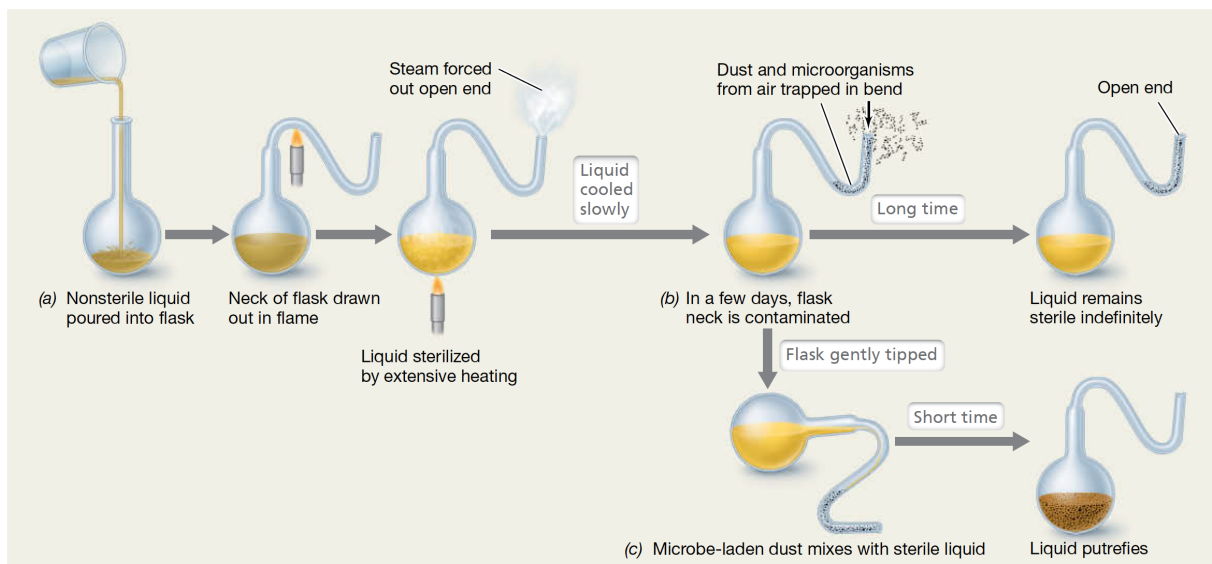
## GERM THEORY OF DISEASE

### 1. Antonie van Leeuwenhoek

- a. Invention of microscope.
- b. Discover microbes around 1650.

### 2. Louis Pasteur & Robert Koch

- a. Proposed germ theory of disease
  - i. Microbes are tiny organisms which cannot be seen by naked eyes, and some can cause disease.
  - ii. A given pathogen can cause a specific disease.
  - iii. Koch's Postulate: Ex. *Bacillus anthracis* causes anthrax; *Mycobacterium tuberculosis* causes tuberculosis.
- b. Pasteur's experiment:



- c. Use attenuated cholera culture to induce immunity to cholera in chickens → Vaccine.

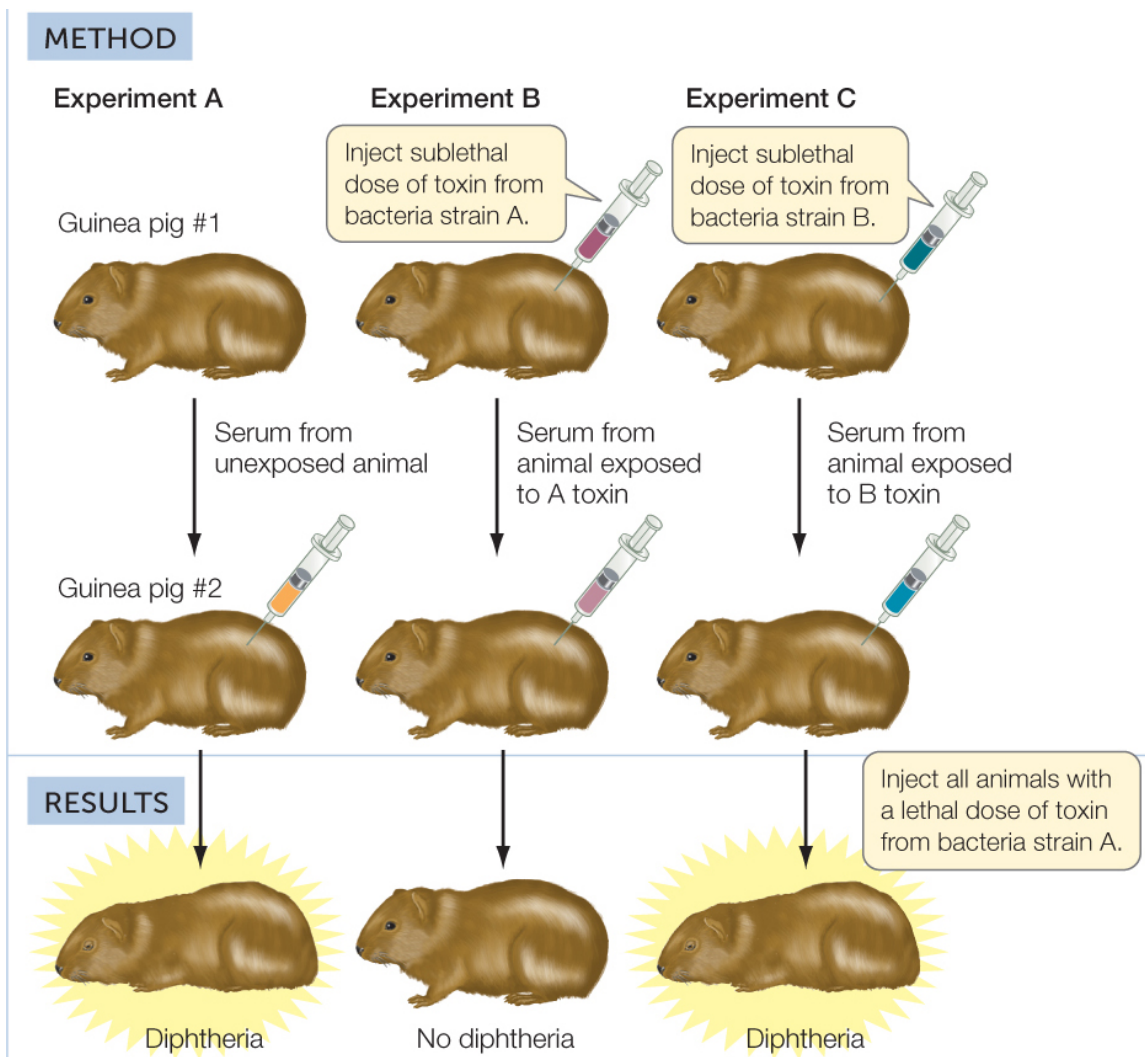
### 3. Rabies

- a. Rabies is caused by infection of a virus in humans through bites from rabid animals.

- b. Dogs get vaccinated.
- c. Vaccinate people who are bitten by animals to block infection (Vaccine post-exposure).

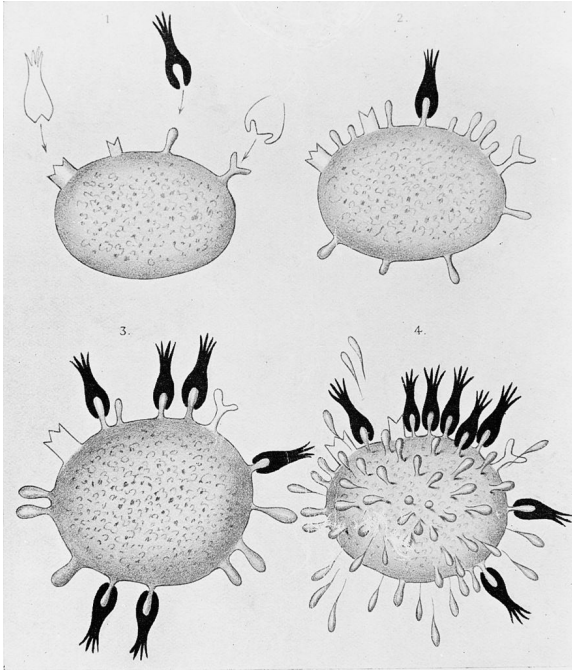
**MODERN IMMUNOLOGY**

1. Ilya Metchnikoff (Nobel Prize in 1908)
  - a. Observed phagocytosis (engulf debris or cells) in starfish larva.
  - b. Metchnikoff hypothesized and demonstrated that human white blood cells can phagocytosis and destroy pathogens.
2. von Behring & Kitasato
  - a. Discovered humoral immunity.
  - b. Serum from exposed animals contained “anti-toxins”, now it is called “antibodies”.
  - c. von Behring & Kitasato experiment:



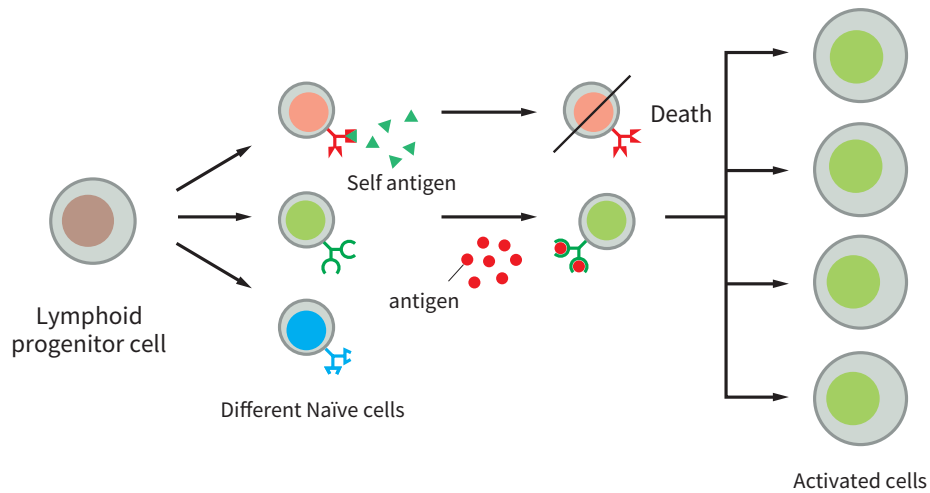
3. Paul Ehrlich (Nobel Prize in 1908)
  - a. “Side chain theory” to explain humoral immunity.

- i. “anti-toxins” are receptors whose structure are complimentary to “toxins” (antigens).
- ii. Binding of toxin to a cell-bound receptor leads to production and release of more of the bound receptors.
- iii. ~~Cells can express various anti toxins which will be selected by antigens.~~ (Wrong)



4. Frank MacFarlane Burnet

- a. Proposed clonal selection hypothesis.
  - i. Each cell produces only one kind of antibody.
  - ii. A specific antigen can stimulate a specific cell which then will undergo clonal expansion.



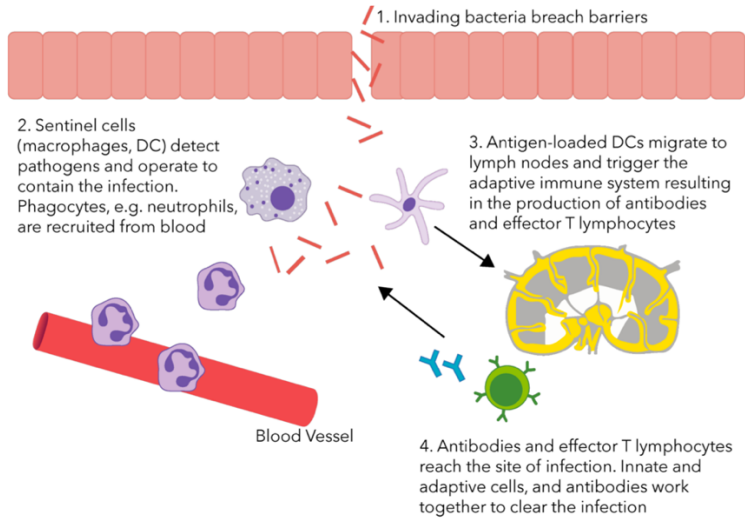
5. Karl Landsteiner and Meryll Chase

- a. a. Proposed about cellular immunity.
- b. Transfer immunity to tuberculin into non-immunized guinea pigs by transferring white blood cells.

c. James Gowans discovered lymphocytes.

6. Charles Janeway

- a. Vaccination only works when adjuvants are added.
- b. Innate immunity is used to prime the adaptive immune system.



GENERATION OF IMMUNE CELLS

- All immune cells are derived from hematopoietic stem cell in bone marrow.

