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OVERVIEW OF IMMUNE SYSTEM

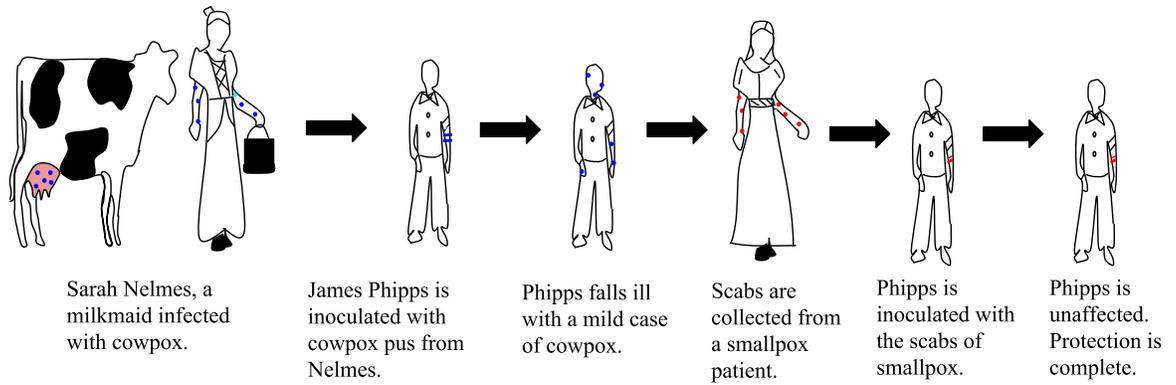
The immune system is a system of tissues, cells and soluble products that recognize, attack and destroy foreign entities that can endanger our health when they enter our bodies.

- 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

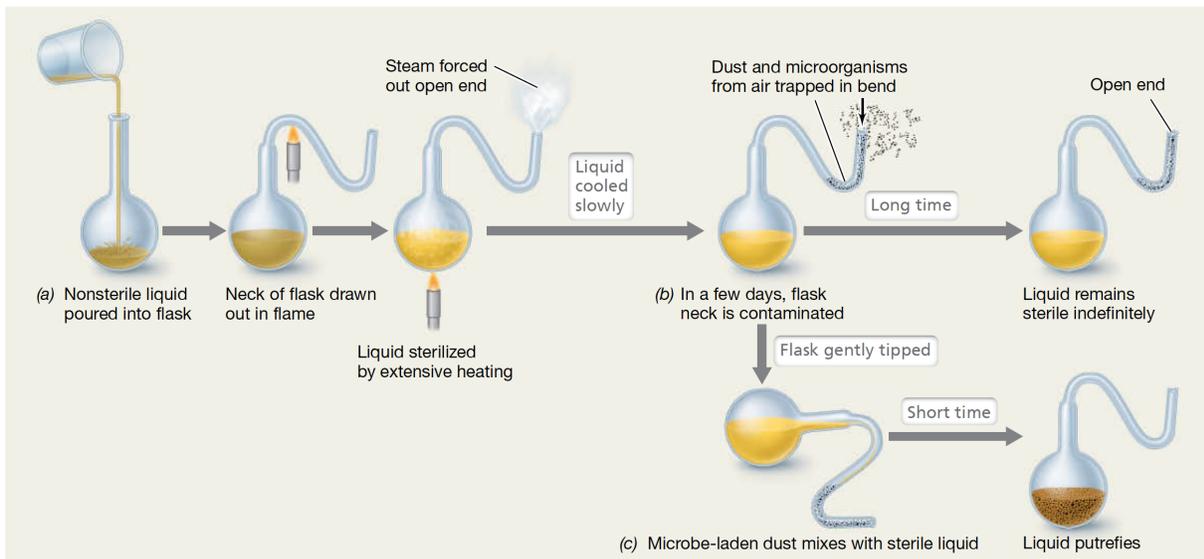
1. Antonie van Leeuwenhoek

- 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:



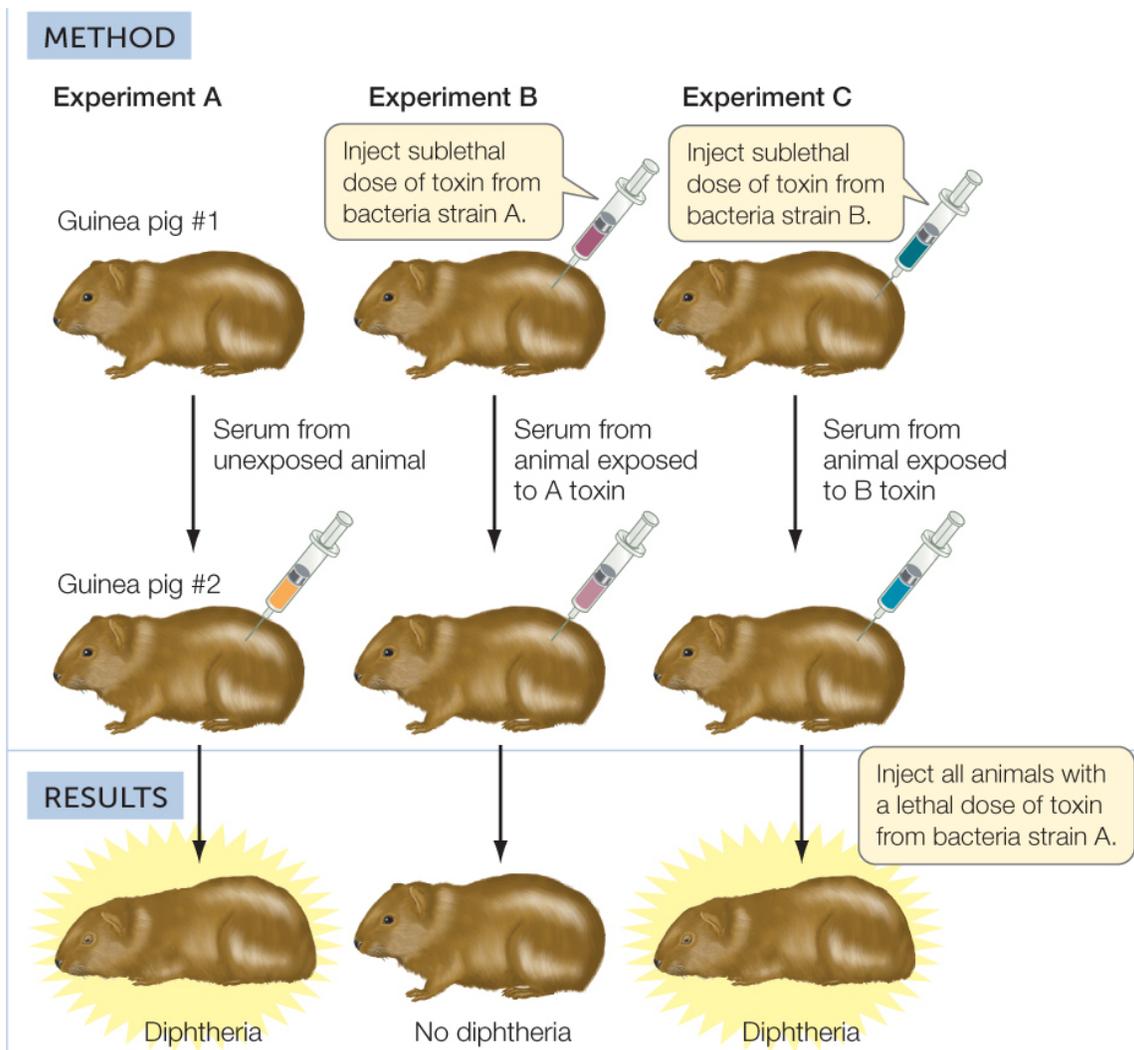
- c. Use attenuated cholera culture to induce immunity to cholera in chickens → Vaccine.

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).

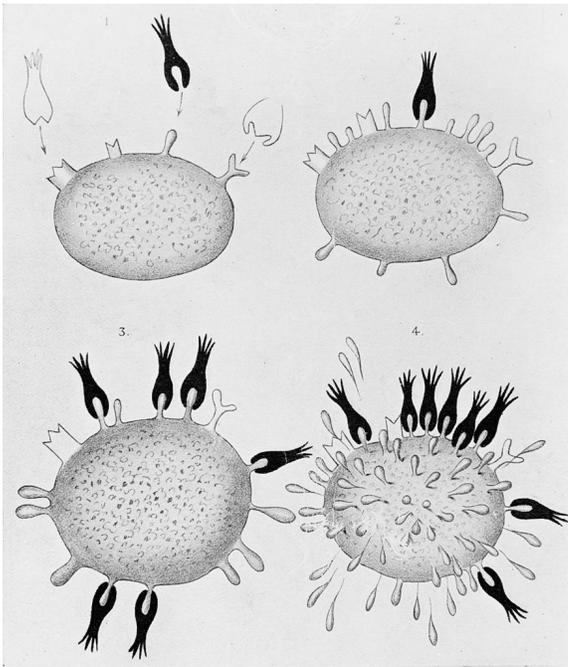
MODERN IMMUNOLOGY

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.

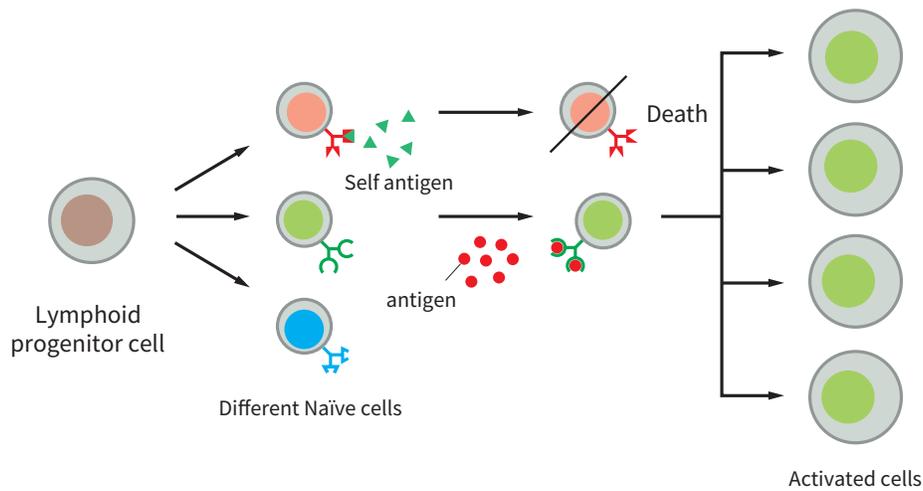
iii. ~~Cells can express various anti toxins which will be selected by antigens.~~ (Wrong)



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.



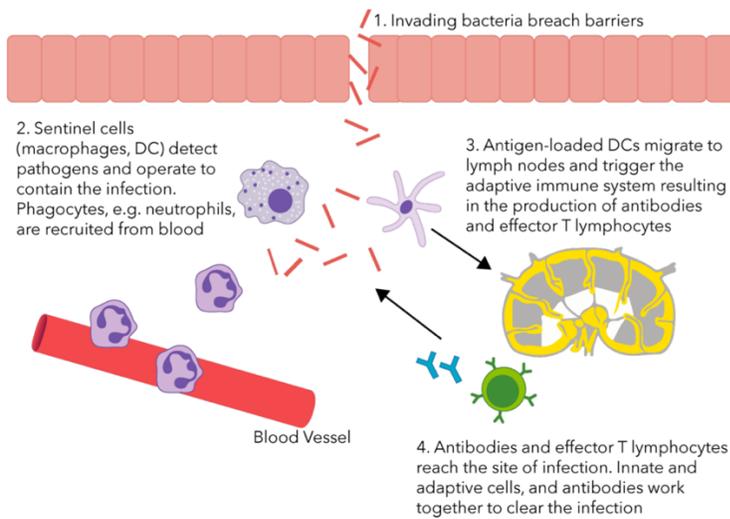
5. Karl Landsteiner and Meryll Chase

- a. 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.

