

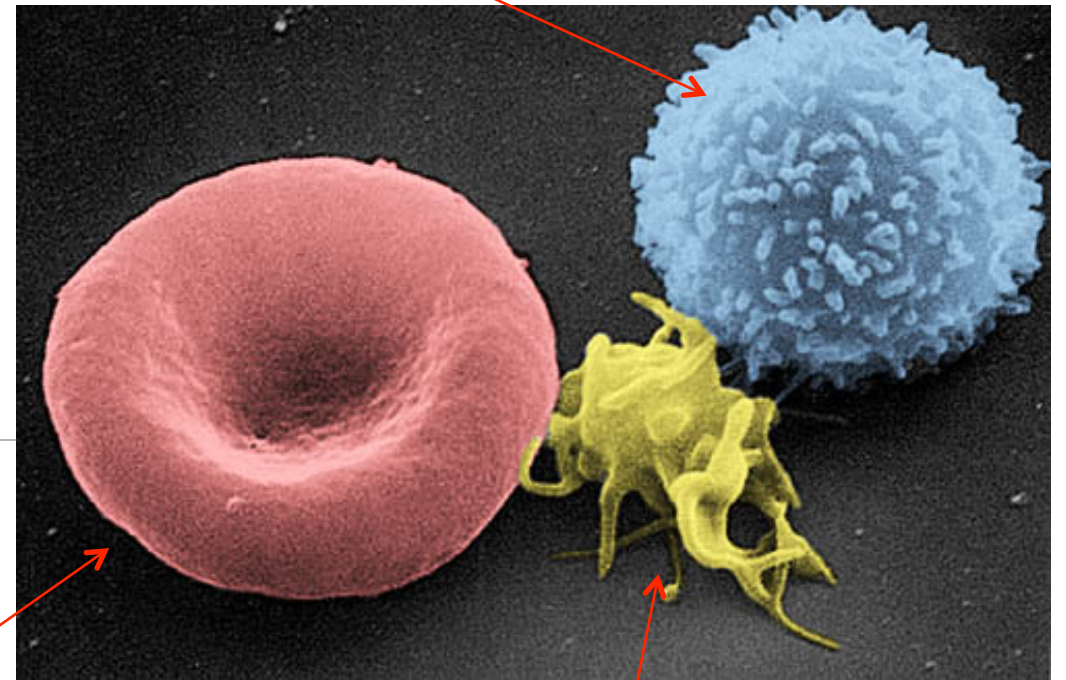
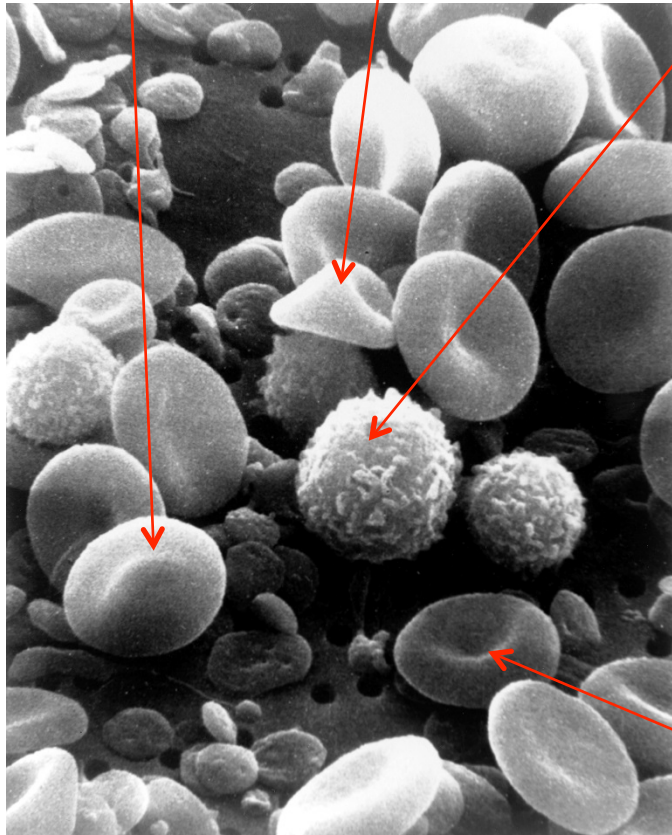
Biological Background of Immune System

Lymphocyte

Monocyte

Neutrophil

March 30, 2017

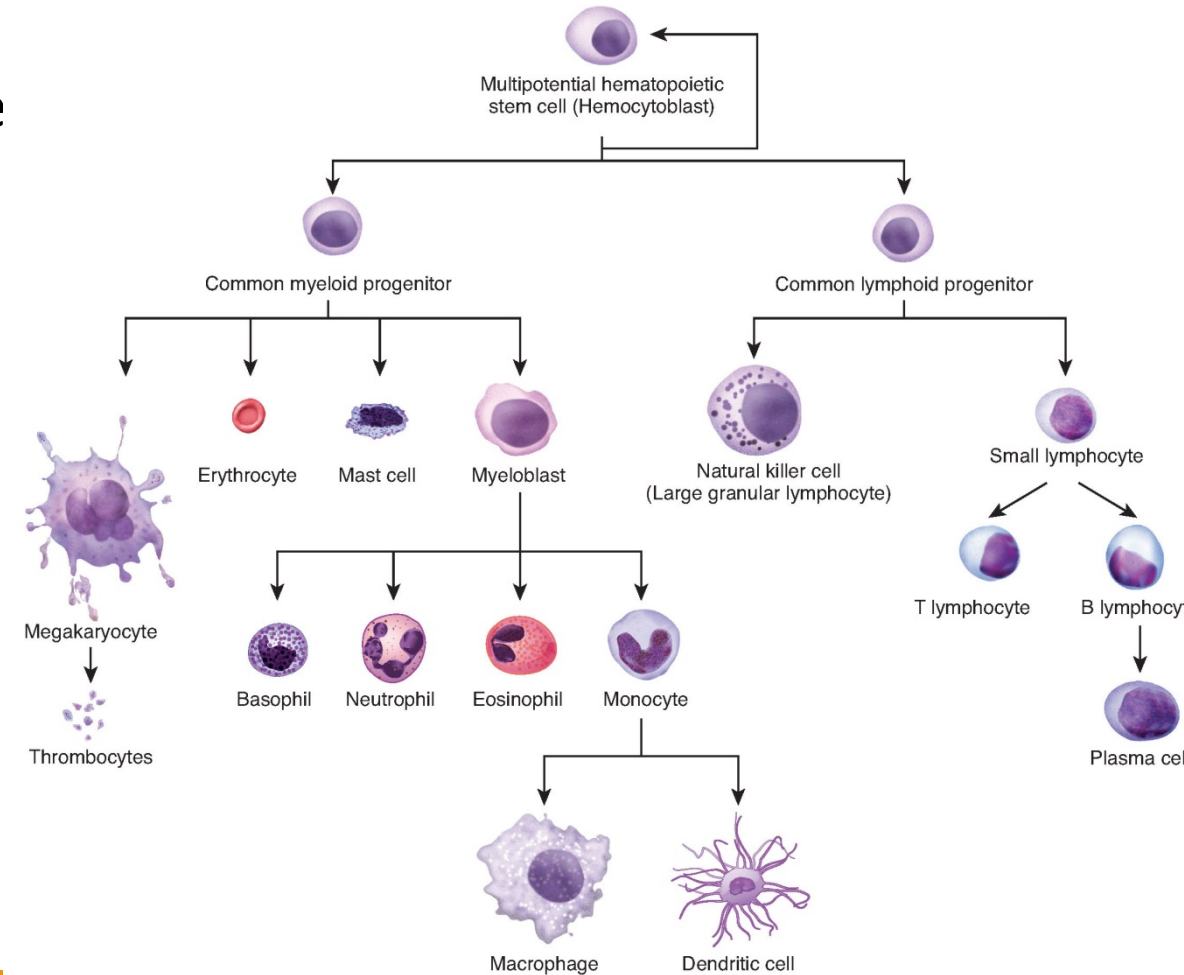


Erythrocyte (RBC)

Platelet

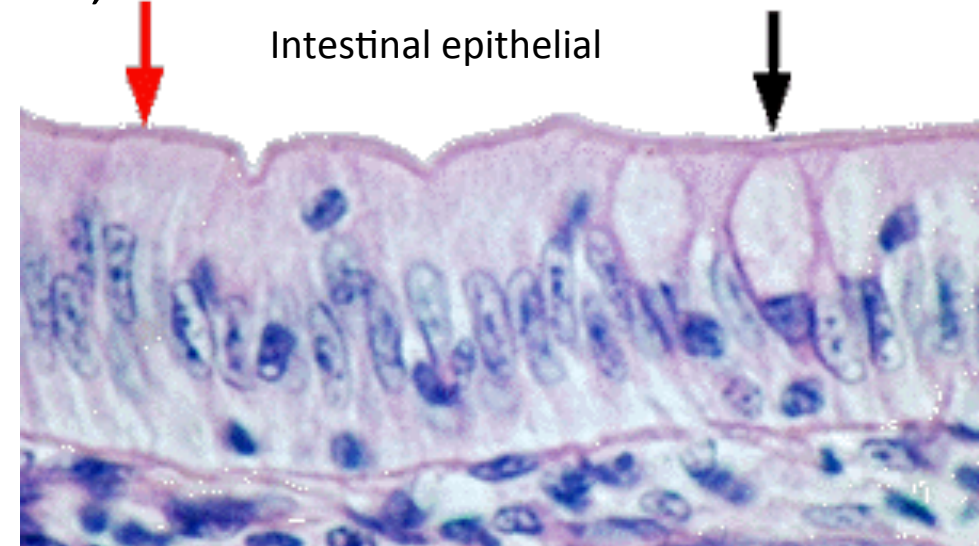
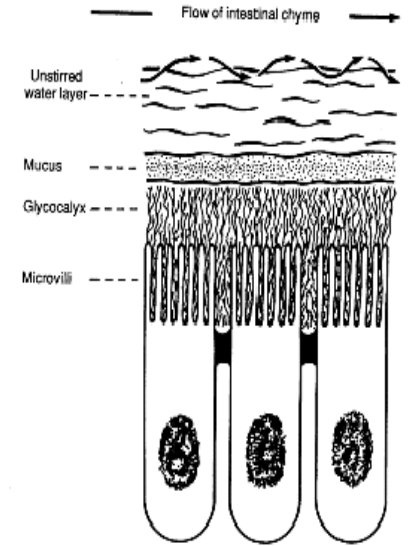
Immunology Basics

- Host defense system comprising many biological structures and processes within an organism that protects against disease
 - Detect between pathogens and healthy tissue
 - **Innate** (non-specific) **vs. Adaptive** (specific)
- Very, very complicated (still not well understood, especially by me)
- **Disorders** – lead to autoimmune diseases, inflammatory diseases, and **cancer**

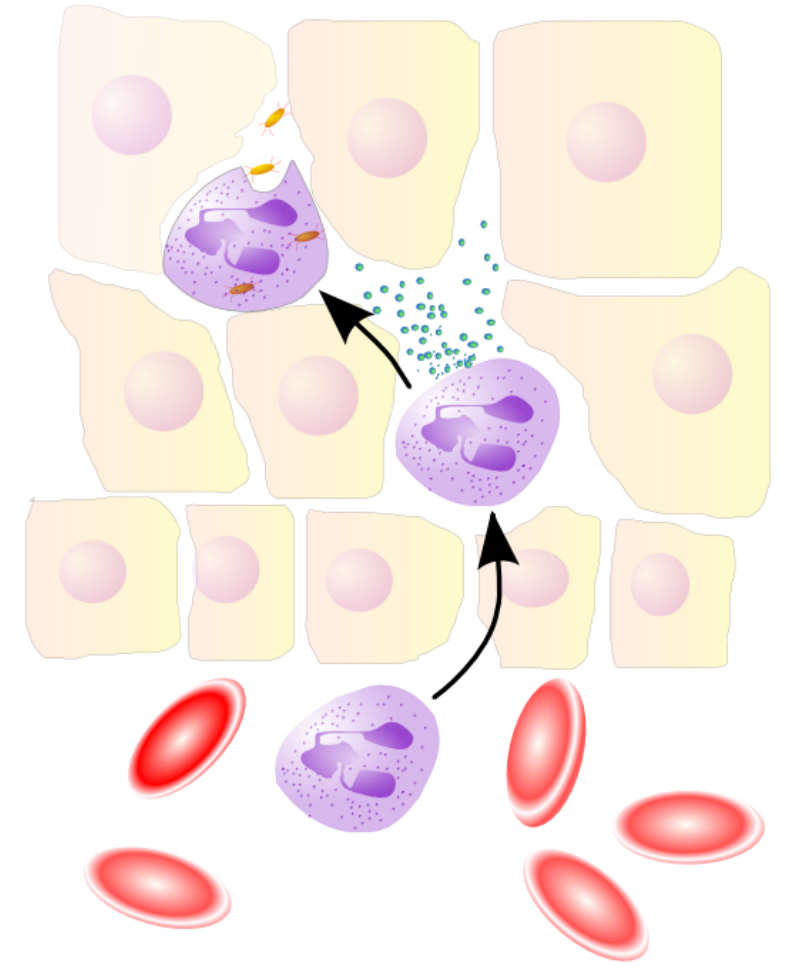
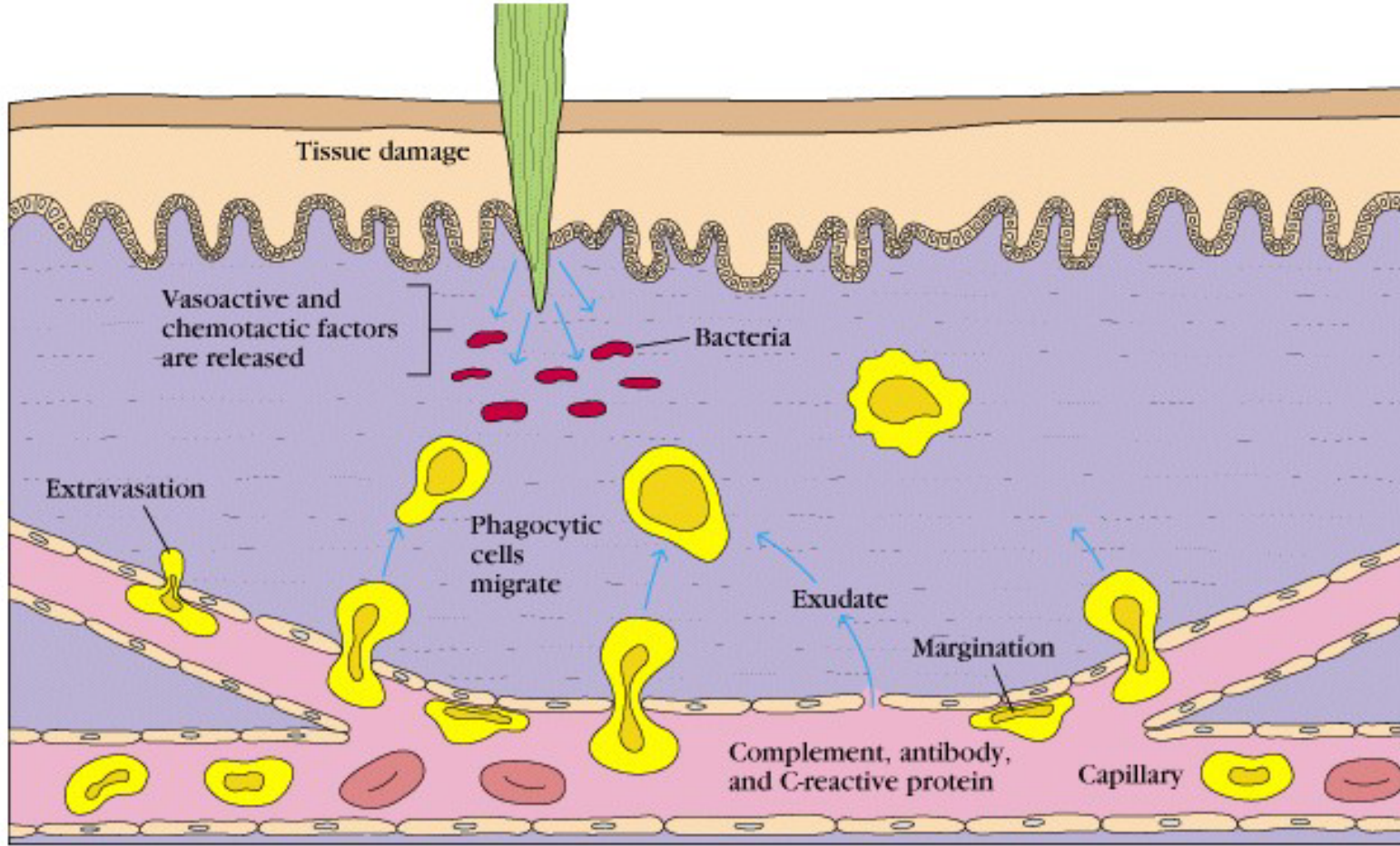


Innate Immune Response

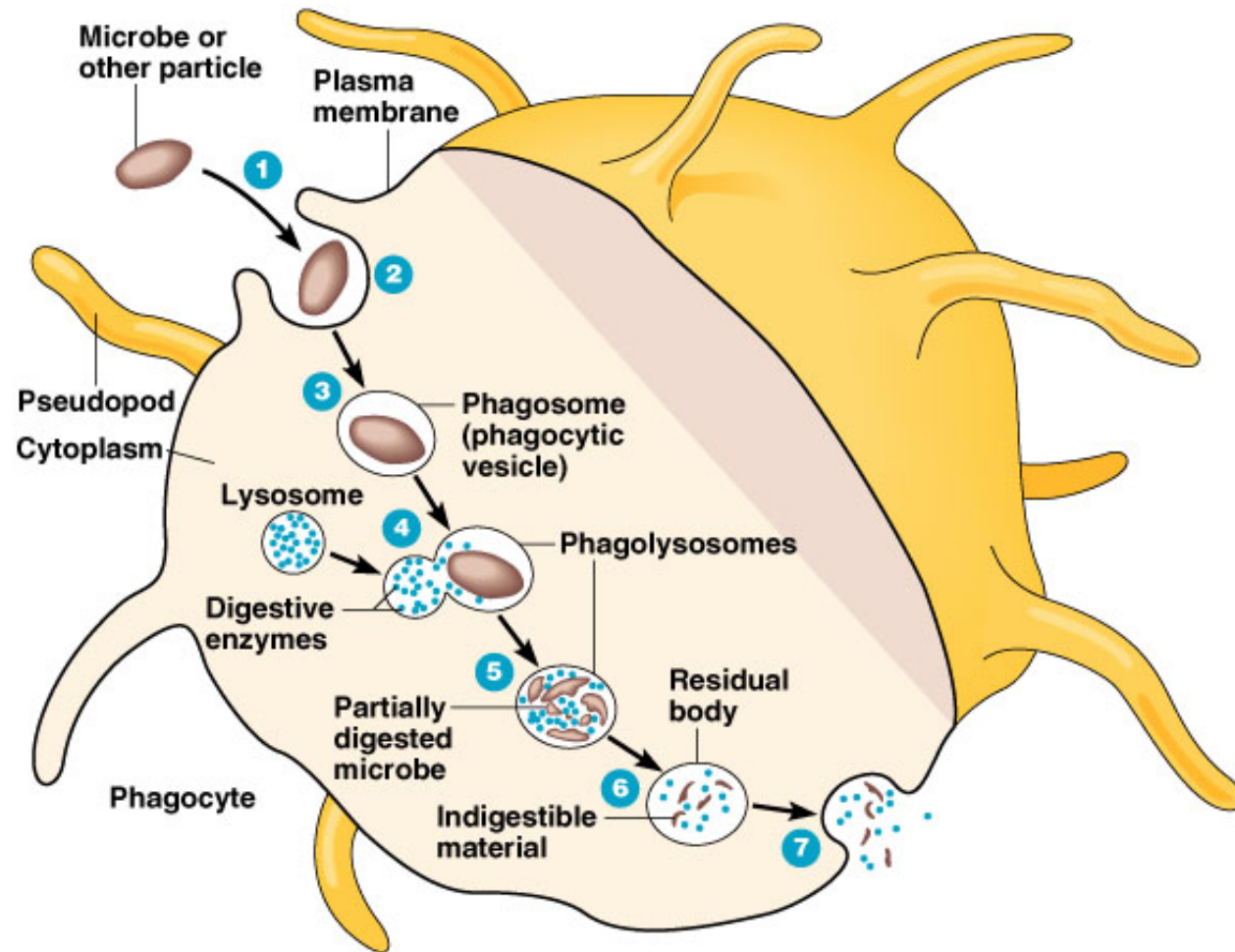
- Respond to pathogens in a generic way
 - No long lasting immunity (unlike adaptive)
- Evolutionarily older, and dominant defense in more primitive organisms
- Major features:
 - Anatomical barriers
 - Physiological conditions (temperature, pH, etc.)
 - Phagocytes – “eating cell,” macrophages, neutrophils, dendritic cells
 - Inflammation
 - Triggered by wound or foreign particle
 - 3 major events:
 - Vasodilation
 - Capillary permeability
 - Influx of phagocytes



Inflammatory Response



Phagocytosis

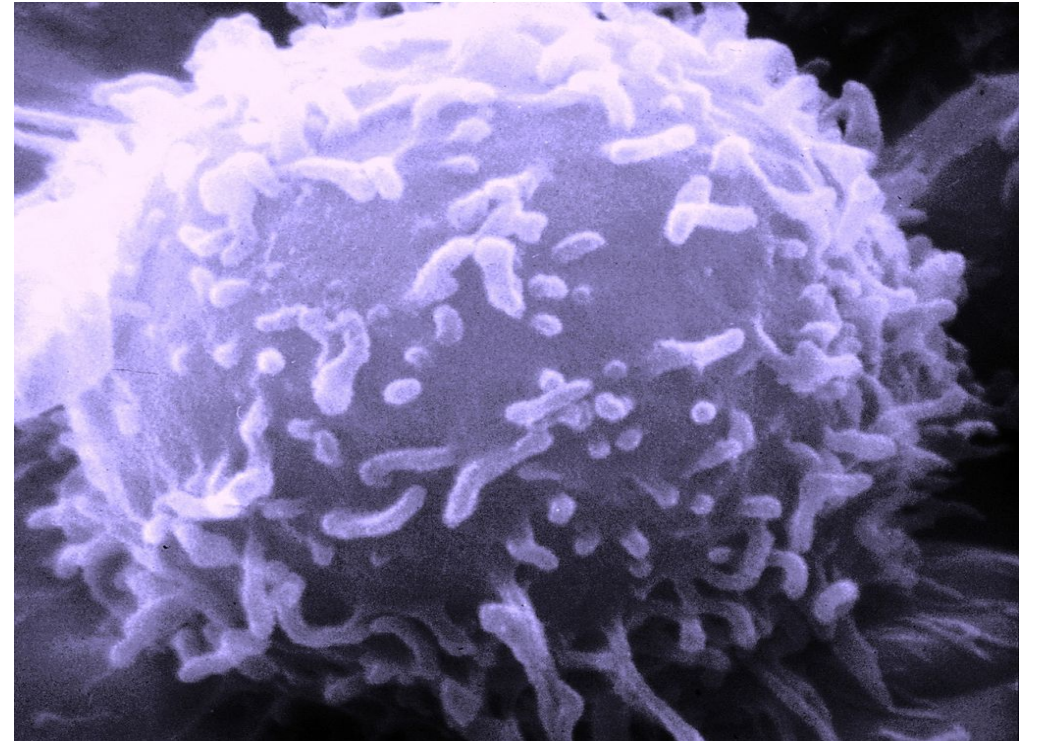


- 1 Chemotaxis and adherence of microbe to phagocyte.
- 2 Ingestion of microbe by phagocyte.
- 3 Formation of a phagosome.
- 4 Fusion of the phagosome with a lysosome to form a phagolysosome.
- 5 Digestion of ingested microbe by enzymes.
- 6 Formation of residual body containing indigestible material.
- 7 Discharge of waste materials.

(a) Phases of phagocytosis

Adaptive Immune System (Acquired)

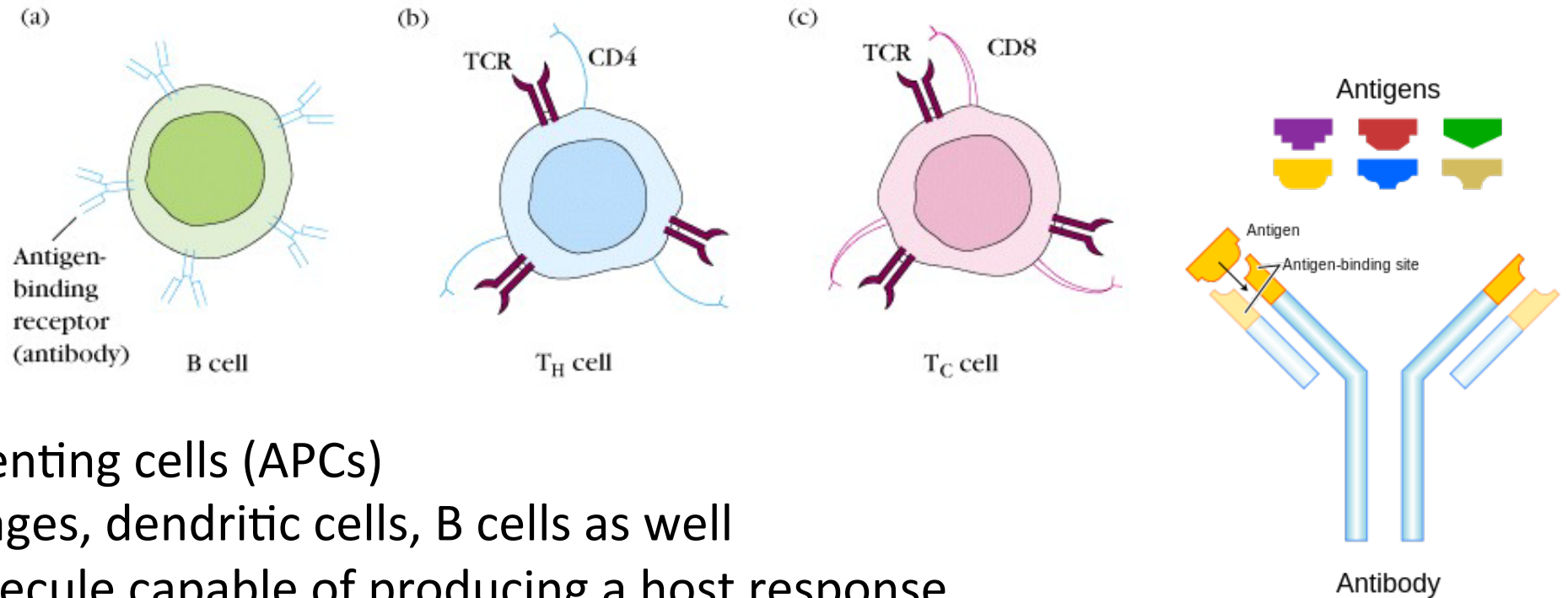
- Composed of highly specialized, systematic cells and processes that eliminate pathogens or prevent their growth
- Creates immunological memory after initial response to a specific pathogen
 - Leads to enhanced response to subsequent encounters
 - Basis of vaccinations
 - Main cells: B and T lymphocytes
 - 4 attributes
 1. Antigen specificity
 2. Diversity
 3. Memory
 4. Self-nonsel self recognition



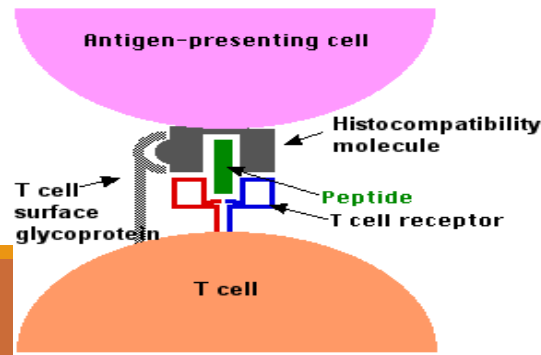
- Note: adaptive and innate immune systems work together and are **interdependent**

Two Main Types of Cells

- B and T lymphocytes

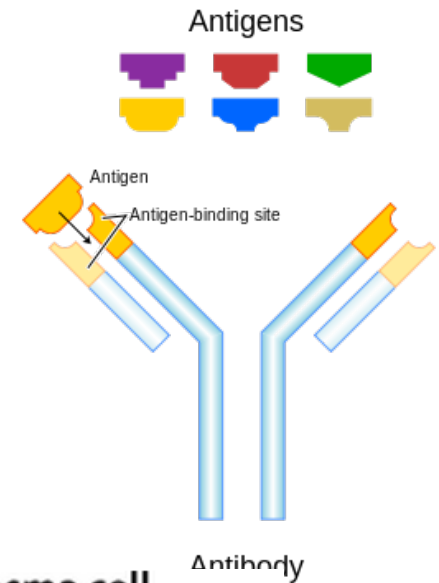
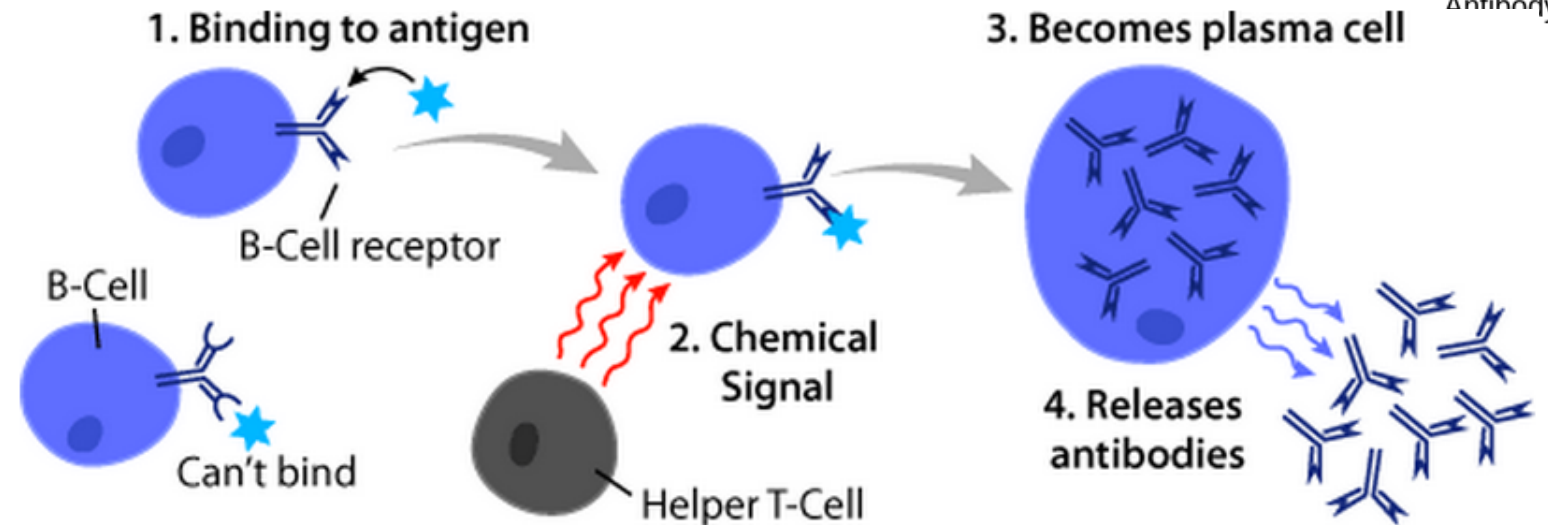
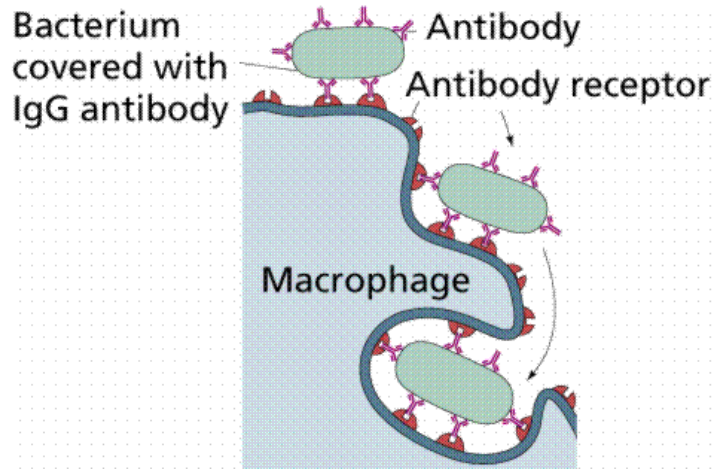


- Antigen-presenting cells (APCs)
 - Macrophages, dendritic cells, B cells as well
- **Antigen:** molecule capable of producing a host response



B Lymphocytes

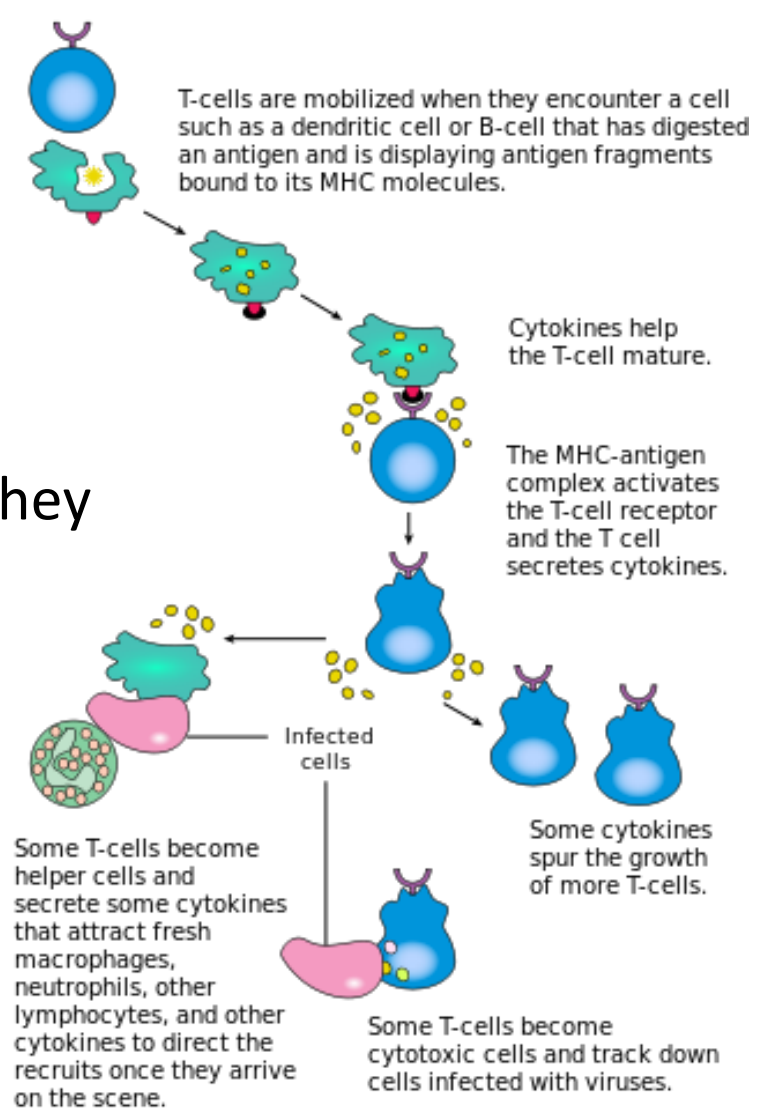
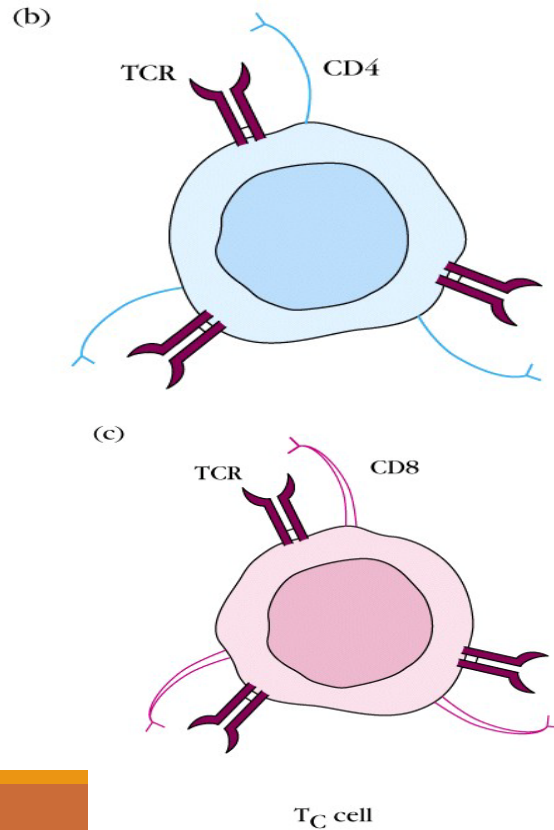
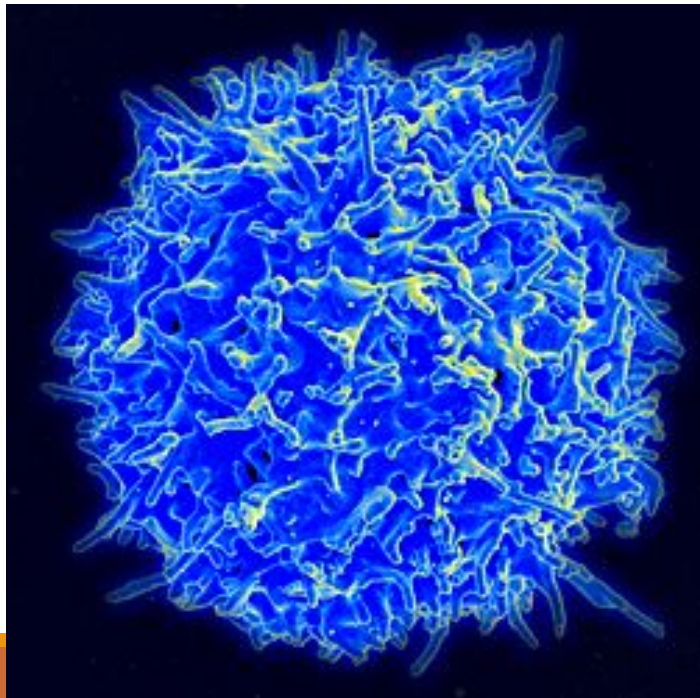
- Humoral component of adaptive immune response
 - Secretes **antibodies** (Ab,Ig) in mature form (plasma cell, effector B cell)
 - **Antibodies:** Tag or neutralize directly



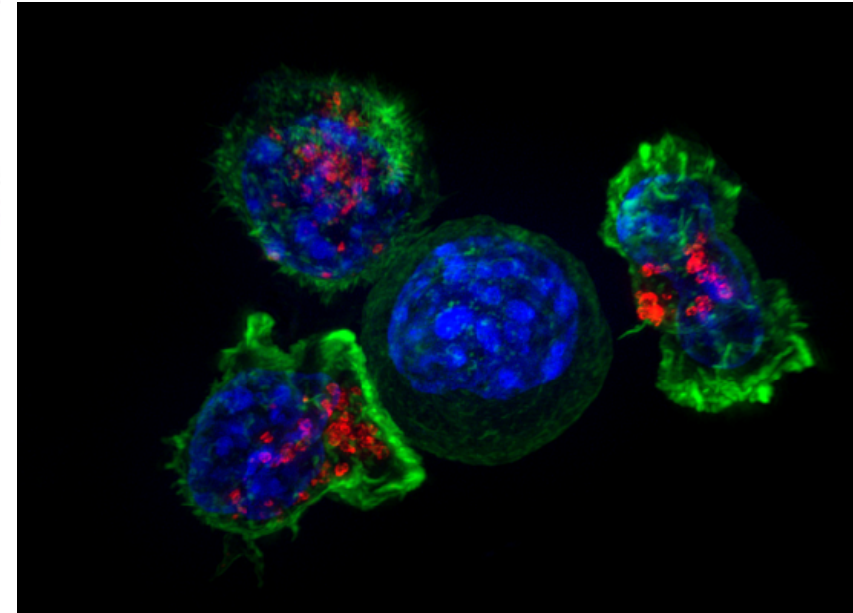
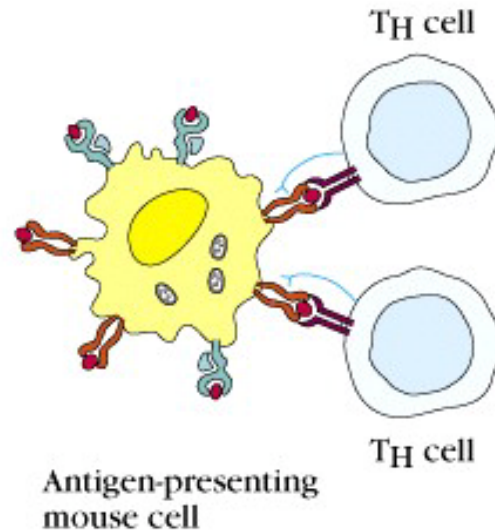
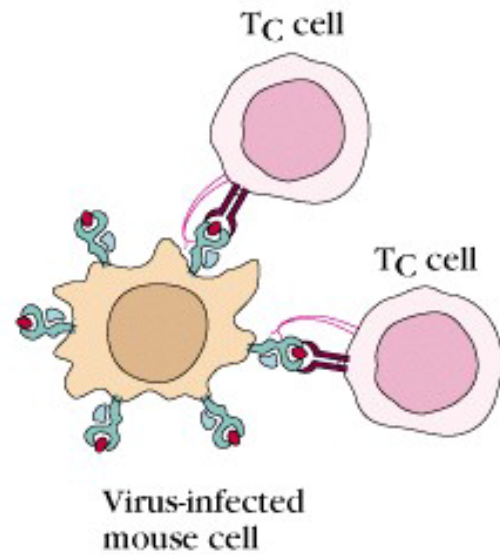
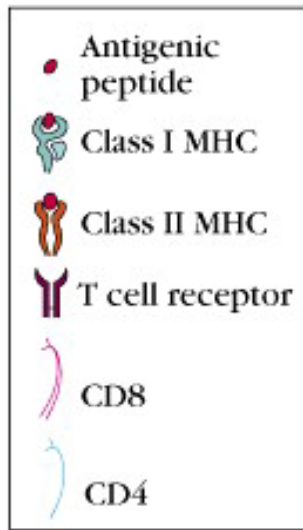
- Can also present antigen (professional APC) and release cytokines (signaling molecules)

T Lymphocytes

- Cell-mediated adaptive immunity
 - Exhibit T-cell antigen receptors (TCRs) on surface
 - 2 types: Cytotoxic T_C , helper T_H
 - Type depends on which type of MHC class molecule they respond to
 - Class I or class II



T Lymphocytes continued



- Different types of immune responses:
 - If T_C cell recognizes an Ag/MHC I complex, it divides and differentiates to become **cytotoxic T lymphocyte (CTL)**
 - If T_H cell recognizes Ag/MHC II complex, it divides and stimulates B cells, T_C cells, etc.

Natural Killer Cells (NKs)

- Part of the innate (but recently thought to be adaptive too) immune response, but similar to cytotoxic T cells (CTLs)
 - Rapid response to infected cells (~ 3 days after infection)
 - Also respond to tumor formation
 - Like T cells, respond to MCH on cell surfaces
 - But have ability to recognize stressed cells in absence of antibodies or MHC, causing a much more rapid response
 - “Natural” – do not need markers MHC class I (self) to kill cells
 - Directly kill, or release cytokines which induce a further immune response
- **Cancer** – MHC class I often downregulated, so only line of defense against tumor growth

