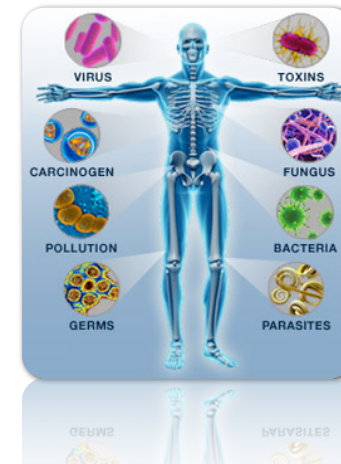


immunity

chapter 48

defenses

- Animal defenses --
 - thinking about immunity
 - two main types
 - innate immunity
 - non-specific defenses
 - adaptive immunity
 - specific defenses



- innate defenses:**
- external - skin, exoskeleton, mucous membranes, cilia, secretions
 - internal -
 - phagocytic cells
 - natural killer cells
 - antimicrobial proteins
 - inflammatory response

- adaptive immunity:**
- lymphocytes
 - immunological memory
 - specific pathogen recognition
 - humoral immunity
 - cell-mediated immunity

innate immunity

- innate immunity
 - barrier defense
 - cuticle of arthropods
 - mucous membranes of molluscs
 - antimicrobial compounds
 - Toll receptors (TLR)
 - produced in fungi, plants, animals...
 - phagocytic cells
 - coelomocytes, amoebocytes, hemocytes
 - sponges, cnidarians, annelids, arthropods, etc...



innate immunity

- vertebrates
 - non-specific defenses against infection
 - epithelial tissue
 - physical and chemical barrier
 - skin acidity
 - washing action secretions
 - antimicrobial proteins
 - lysozyme

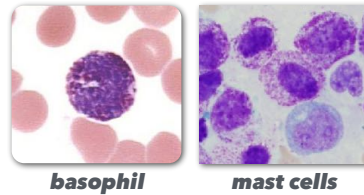
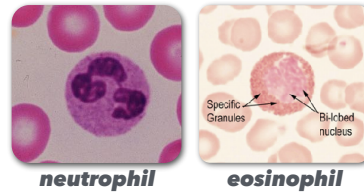


Stevens-Johnson syndrome

innate immunity

• non-specific cellular defenses

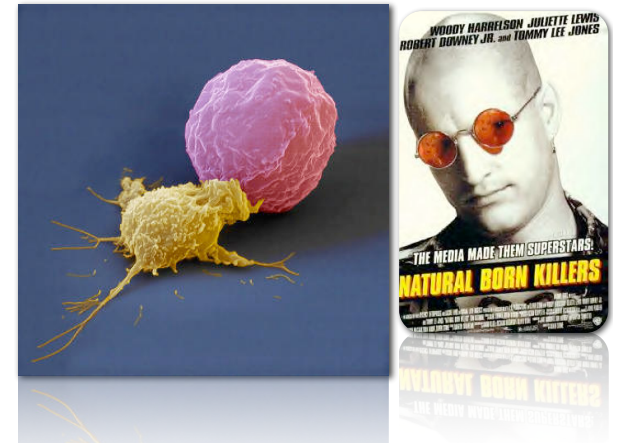
- TLR - Toll-like receptors
- granulocytes (polymorphonuclear leukocytes)
 - neutrophils — 60-70% of white cells
 - eosinophils — 2-5% of white cells
 - multicellular threats
 - basophils — 0.5% of leukocytes
 - degranulate - initiate inflammation
 - mast cells — tissues
- phagocytic white blood cells
 - monocytes --
 - 5% of white cells



innate immunity

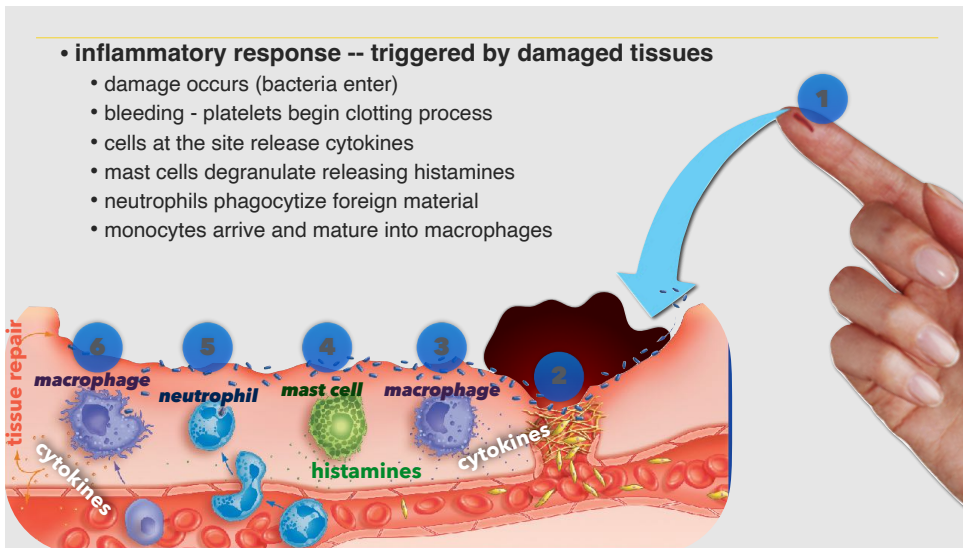
• NK cells

- large granular lymphocytes (LGL)



• inflammatory response -- triggered by damaged tissues

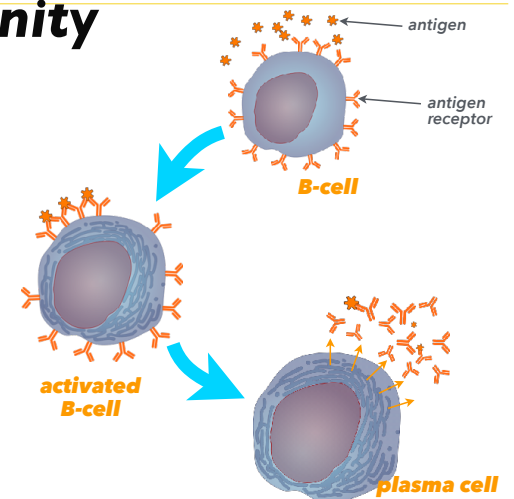
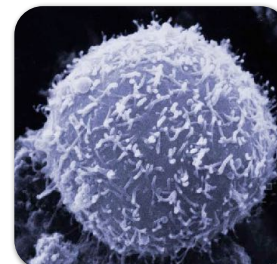
- damage occurs (bacteria enter)
- bleeding - platelets begin clotting process
- cells at the site release cytokines
- mast cells degranulate releasing histamines
- neutrophils phagocytize foreign material
- monocytes arrive and mature into macrophages



adaptive immunity

• specific cellular defenses

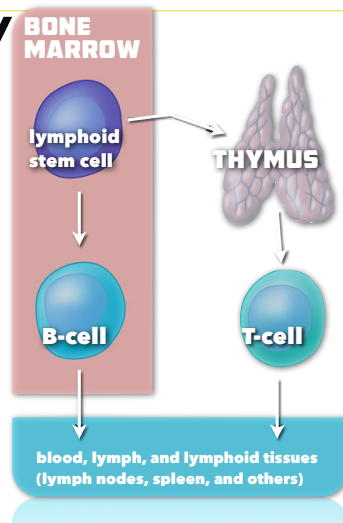
- internal
- Lymphocytes
 - B-cells
 - antibodies
 - T-cells



adaptive immunity

development of self vs. non-self

- b-cells - bone marrow
- t-cells - thymus

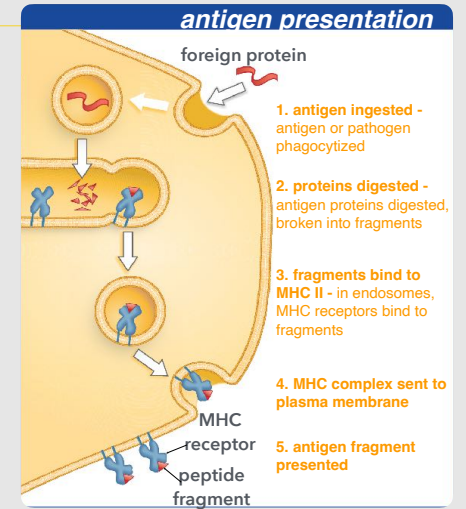


self recognition

- MHC molecules
- class I MHC molecules
 - bind to **cytotoxic** T-cells
- class II MHC molecules
 - bind to **helper** T-cells
- during development, exposed to both types

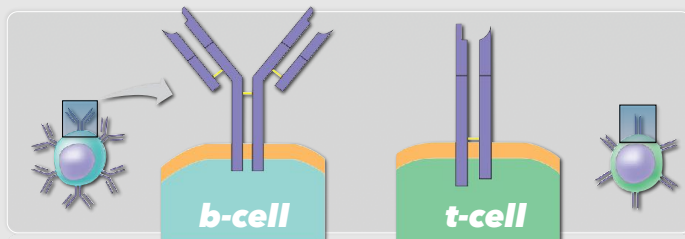
antigen presentation

- MHC molecules present protein fragments at cell surface
- some are foreign, some are not



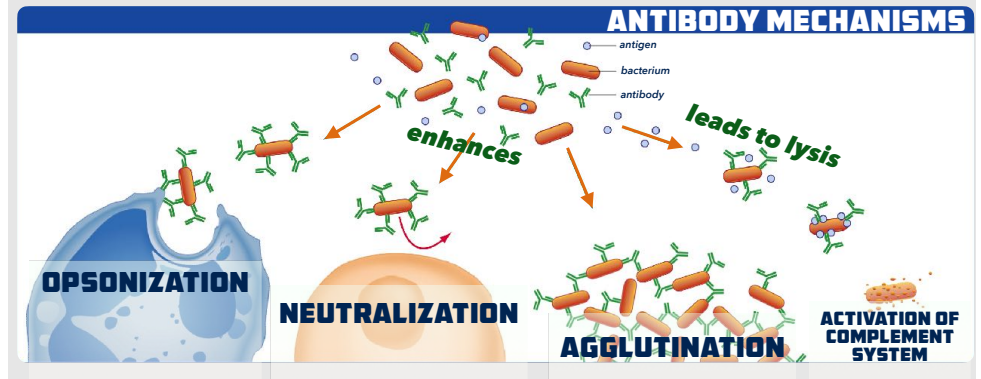
antigen receptors --

- each cell has a single type of receptor
- B-cells
 - plasma cells, memory B-cells
- T-cells
 - helper - CD4+ — T_{H1}, T_{H2}
 - cytotoxic - CD8+
 - memory



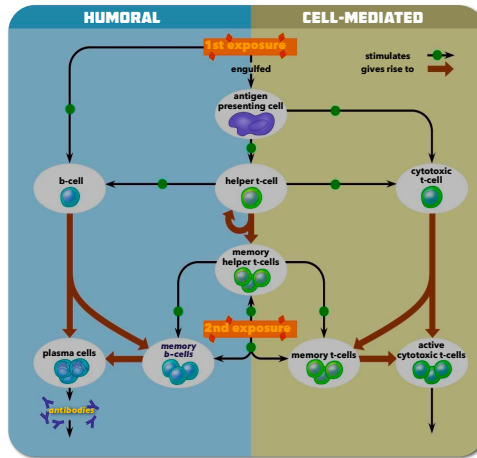
antibodies

- enhance phagocytosis
- neutralize toxins
- cell lysis



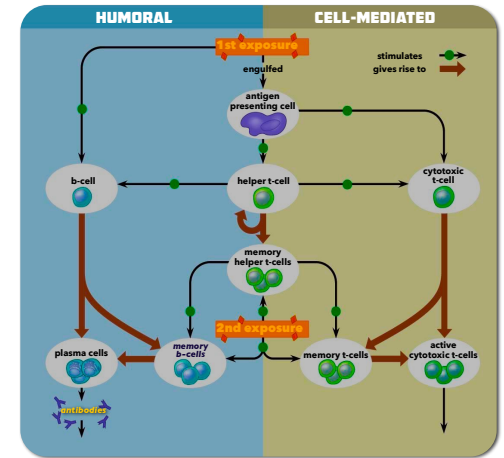
adaptive immune response

- **humoral immunity**
 - mainly effective against bacteria, viruses, and toxins in body fluids.
- **cell-mediated immunity**
 - mainly effective against infected cells and cancerous cells
- **clonal selection**
 - activated lymphocytes divide and copy themselves



adaptive immune response

- **primary immune response**
 - first exposure
 - 10-17 days
 - clonal selection
- **secondary immune response**
 - quicker, stronger response
 - immunological memory



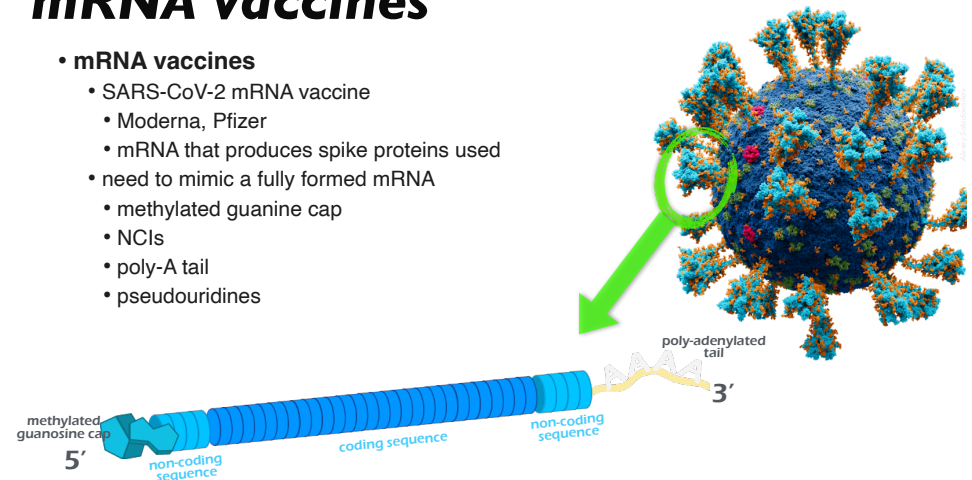
• vaccination/immunization

- active immunity
- passive immunity
- **vaccine types**
 - subunit
 - inactivated
 - attenuated
 - mRNA



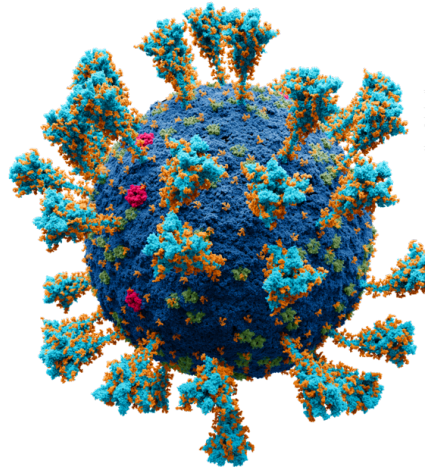
mRNA vaccines

- **mRNA vaccines**
 - SARS-CoV-2 mRNA vaccine
 - Moderna, Pfizer
 - mRNA that produces spike proteins used
 - need to mimic a fully formed mRNA
 - methylated guanine cap
 - NCIs
 - poly-A tail
 - pseudouridines



covid vaccines

- types
 - viral vector
 - Oxford-AstraZeneca (Covishield)
 - Johnson & Johnson
 - mRNA
 - Moderna
 - Pfizer



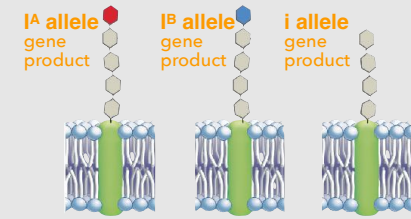
transplants

- organ transplantation
 - anti-rejection drugs
 - living-related, cadaveric
- MHC testing --
 - highly variable HLA profiles
 - must be ABO match
 - must be good HLA match
 - they look at 3 MHC loci (best match is a 6)



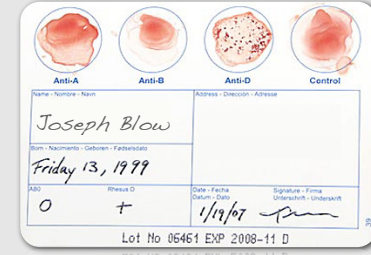
• ABO blood groups...

- A, or B, or AB, or O
- alleles: $I^A I^B i$
- A ($I^A I^A$ or $I^A i$)
- B ($I^B I^B$ or $I^B i$)
- AB ($I^A I^B$)
- AB
- O (ii)



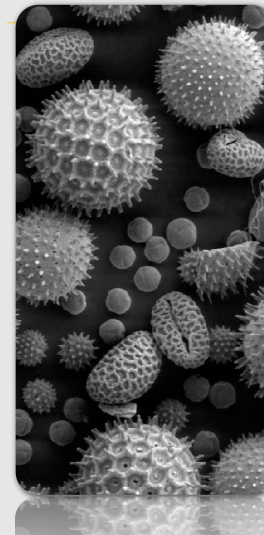
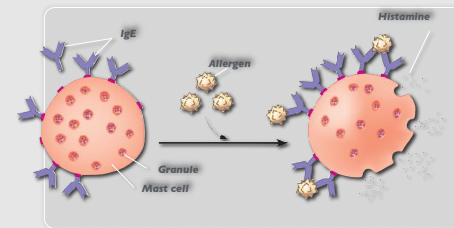
• RH factor...

- antigen on a transmembrane protein (probably an ion channel)



• allergies --

- inappropriate reaction to an antigen (allergen)
- IgE antibodies
 - bind to mast cells and basophils
- genetic and environmental component



• anaphylaxis or anaphylactic shock...

• urticaria

