Immunity = the ability to resist damage from pathogens, such as microorganisms; harmful chemicals, and internal threats

Types of Immunity

**Innate Immunity = (Aquired immunity)** = an immunological system that is the first line of defense from an infection. It is essentially made up of barriers that limit the ability of a pathogen to enter or spread throughout the body. This response is the same every time the body is exposed to a pathogen

**Parts**

Physical barriers – skin, gastrointestinal and respiratory tract, cilia, eyelashes, etc.

Washing barriers – secretions, mucous, bile, gastric acid, saliva, tears, sweat

Chemical mediators – lysozyme in tears and saliva kill bacteria

Cytokines cause vasodilation, increase vascular permeability, and stimulate phagocytosis

Interferon – protects against viral infections

Complement – over 20 proteins in plasma that continuously circulate in the blood and, when activated, cause a chain reaction resulting in inflammation, increase of phagocytosis, and sometimes bacterial cell death.

General immune response – inflammation, complement, non-specific immune cells

**Types of Cells**

Phagocytes = cells that engulf and destroy particles

Macrophages – lymphocytes that can move across capillary vessels and hunt pathogens within body tissues

Neutrophils – phagocytic granulocytes that have granules that are toxic to bacteria and fungi.

**Cells of Inflammation →** release histamine, and other chemicals

Mast cells – Found in mucous membranes and connective tissues and important for inflammatory response. When activated they release chemicals that cause blood vessels to dilate, and cells to make their way to the site of infection.

Eosinophils – granulocytes that target multicellular parasites by secreting a range of highly toxic proteins and free radicals. The proteins and free radicals also cause allergic reactions.

Basophils - granulocytes that attack multicellular parasites by releasing histamine, which also causes allergic reaction
**Innate Immunity (continued)**

Natural Killer Cells (NK cells) – cells that destroy infected host cells in order to stop the spread of an infection. Recognize cancer cells, infected cells without specificity. Release chemicals that lyse cells (poke holes in them).

Dendritic Cells – antigen-presenting cells located in tissues that can be in the skin, mucous, intestinal lining, and other tissues that are often part of the initial infection. They identify the threat and secrete chemicals that notify cells of adaptive immunity.

Process of Inflammatory Response
- Bacteria enter tissue →
- Tissue damage occurs →
- Chemical mediators are released →
  - Chemotaxis, increased vascular permeability, increased blood flow →
  - Increased numbers white blood cells & chemical mediators at site of damage →
- Bacteria are contained, destroyed, phagocytized →
- Bacteria gone
  (if any remain more chemical mediators are released, process continues)

Local inflammation = inflammation limited to a specific part of the body
- Symptoms of redness, heat, swelling, and sometimes pain

Systemic inflammation = inflammatory response generally distributed throughout body
- Symptoms: redness, heat, swelling and release of large numbers of neutrophils
- Release of pyrogens: chemicals cause hypothalamus to increase body temp. →
  - Increase phagocytosis and
  - Increase release and action of chemical mediators
- Can cause so much vascular permeability & fluid loss that person goes into shock

Innate Immunity does not cause allergic reactions

Chemotaxis = movement of white blood cells towards chemicals released by pathogens or damaged blood vessels
Adaptive = *(specific immunity)* = an immunological system that creates a memory of the foreign particle or microorganism resulting in a stronger immunological reaction every time the person is exposed.

Specificity = the ability of adaptive immunity to recognize a particular substance

Memory = the ability of adaptive immunity to “remember” a particular substance from previous encounters.

Antigen = a substance that stimulates an adaptive immune response

Antigen receptor = proteins on a lymphocyte cell surface that recognize an antigen and can initiate an adaptive immune response.

Major Histocompatibility complex (MHC) = group of genes that code for proteins found on the surfaces of cells that help the immune system recognize foreign substances. They are glycoproteins that have binding sites for the antigens.

2 types of antigens
- Foreign = anything outside the body, ex. Microorganisms, dust particles, etc.
- Self = molecules of the body produced to stimulate an immune response
  Ex. Recognition of tumor cells or cells infected by viruses

2 types of Adaptive Immunity
- Antibody mediated immunity = involves B cells (plasma and memory cells)
- Cell mediated immunity = involves T cells (cytotoxic and helper T cells)

Cell mediated immunity – effective against tumors, viruses, intercellular bacteria

Before antigen exposure lymphocyte number and size are small

Macrophage recognizes an antigen and processes it

Macrophage presents antigen on cell surface, secretes chemical mediators

Helper T cells respond to the presented antigen and chemical mediators by
- Secreting chemical mediators that activate B cells
- Stimulate helper T cells to divide, activate helper T cells → Activated helper T cells divide → memory T cells
  more activated T cells
cytotoxic T cells → divide → memory cytotoxic T cells
activated cytotoxic T cells →
  1. kill cells with antigen on cell surface using porforin – a chemical that stabs a cell, lysing it
  2. activate inflammatory response
  3. attract macrophages
**Antibody mediated immunity** – effective against anything that is not inside the cell

**Primary response**
- first exposure of B cells to antigen + helper T cell chemical mediators →
- B cell divides → memory B cells and plasma cells
- Memory B cells stay in the system
- Plasma cells → divide → secrete antibodies that recognize the antigen
- Antibodies → a number of different effects depending on antibody type
- Takes 3 – 14 days
- Causes disease symptoms because microorganism or virus has time to damage tissue.

**Secondary response**
- “memory response”
- Second or more exposure of B cells to antigen + helper T cell chemicals →
- B cell divide immediately → memory B cells and plasma cells → response
- Takes hours to a few days
- So rapid a response that no tissue is damages, no symptoms →
- Person is “immune”

Active immunity = body exposure to antigens cause the body itself to have an immune response

Passive Immunity = a person or animal develops immunity, which is transferred to another individual

Natural Immunity = exposure is part of everyday life

Artificial immunity = exposure is a deliberate act of human choice

Examples:
- Active natural immunity = influenza, exposure to toxins in the environment, food poisoning
- Active artificial immunity = vaccines
- Passive natural immunity = antibodies that cross the placenta from a mother to an embryo or fetus
- Passive artificial immunity = immunoglobulin shots where antibodies are taken from one person and injected into another

Antiserum = antibodies (immunoglobulins), they are called this because they are found in and isolated from serum in order to use for passive artificial immunity

Stem cells = cells in red bone marrow capable of giving rise to all types of blood cells

Autoimmune disease = self-antigens that stimulate unwanted destruction of body tissue
Antibody Structure

- Four chains: two light (pink), two heavy (blue)
- Two regions: variable (light shade), constant (dark shade)

Antigen binding site: variable part of both heavy and light chains that is specific for an antigen

Constant part of antibody: same for all antibodies of that type

Antibody Types:

**IgG**
- Present in the largest numbers
- Activates complement and increases phagocytosis
- Neutralizes bacteria so they can no longer infect
- Can cross the placenta
- Responsible for Rh reactions (because it crosses the placenta)

**IgM**
- Largest and heaviest
- Activates complement
- Activates B cells
- Neutralizes pathogens (makes it so they can no longer infect)
- Agglutination (sticks together to make masses that can no longer be carried by blood)
- Often first antigen to arrive at the site of an infection
- Responsible for the ABO blood type reactions

**IgA**
- Secreted into saliva, tears, mucous membranes
- Found in breast milk – confers immunity to newborn
- Traps pathogens in mucus
- Neutralizes pathogens so they can no longer cause an infection

**IgE**
- Binds to mast cells and basophils, activating them against parasites and allergens
- Stimulates the inflammatory response
- Least numerous

**IgD**
- Antigen-binding receptor on B cells
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