

- **Eosinophils:** Often, they secrete antimicrobial chemicals to kill worms.
  - Eosinophils have been observed to utilize mitochondrial DNA as an antimicrobial agent.
- **Natural Killer Lymphocytes (only one cannot undergo phagocytosis; the other two can)**
  - Works by secreting toxins onto the surfaces of virally infected cells and tumors.
- **Neutrophils**
  - Enzymes can make superoxide radical  $O_2^-$ , hydrogen peroxide, hypochlorite, and nitric oxide.
  - They can also generate a neutrophil extracellular trap (NET) to capture gram+ and gram- bacteria. Antimicrobial peptides then kill the bacteria.

**10. Define Toll-like receptors and describe their action in relation to pathogen-associated molecular patterns.**

- **(TLRs)** are proteins in the membranes of phagocytic cells that act as an early warning system, triggering the body's responses to any molecule *shared by viruses or bacteria but absent in human*. Pathogen exclusive molecules are referred to as **pathogen-associated molecular patterns** (PAMPs).

**11. Explain the roles of interferons in innate immunity.**

- **Interferons** are proteins released by host cells to nonspecifically prevent the spread of viral infections.
- The subgroups Alpha ( $\alpha$ ) and beta ( $\beta$ ) are present early in an infection as the innate immune system.
- Alpha and beta interferons bind to neighboring uninfected cells. The binding of interferons produces antiviral proteins (AVPs), which remain inactive until a virus attempts to infect the cell.

**12. Describe the complement system, including its three activation pathways. You don't need to know every single molecule in the classical pathway, just the key features: what triggers it, how it kills microbes.**

- The **complement system** is a set of proteins that initially act as opsonins and chemotactic factors and indirectly trigger inflammation and fever. The result of full complement activation is lysis of foreign cells.
- Complement proteins react with one another in which the product of each reaction becomes an enzyme that catalyzes the next reaction many times over.
- **Classical Pathway**
  - Activated by C1 enzyme when it binds to an antibody-antigen complex.
  - After a series of events, a MAC complex drills a hole in the pathogen's membrane.
- **Alternative Pathway**
  - Activated by the cleavage of C3 enzyme into C3a and C3b. Then C3b binds to the cell wall or microbial surface. *[The cell dies in the exact same way as classical.]*
- **Lectin Pathway**
  - Involves lectins, chemicals that bind to specific sugar subunits of polysaccharides.

**13. Discuss the process and benefits of inflammation.**

- The benefits of inflammation are **increased dilation** of blood vessels, **attraction of immune** cells, and beginning of **wound repair**.
- A **signaling system** alerts body of injury.
- There is increased vasodilation in injured tissues in response to Bradykinin and Histamine.
  - Blood brings more phagocytes, oxygen and nutrients.
- Increasing heat and redness is given off by the increased blood flow. Escaping fluid causes swelling.
- Pain is experienced as nerve endings are stimulated.

**14. Explain the benefits of fever in fighting infection.**

- Enhances the effects of interferons
- Inhibits the growth of some microorganisms
- Enhances the performance of phagocytes,
- Enhances the activity of immune cells and the process of tissue repair.