

## IMMUNE SYSTEM

### ORGANS



- **LYMPH NODES**-filter/trap foreign particles; store B & T cells
- **SPLEEN**- stores blood cells; removes antibody coated cells
- **ADENOIDS (TONSILS)**-trap bacteria/antigens
- **BONE MARROW**- stem cells make blood cells; B lymphocytes mature here
- **THYMUS**- produce and "educate" T lymphocytes

NON SPECIFIC INNATE IMMUNITY- born with ability; treats all pathogens same

#### 1. FIRST LINE OF DEFENSE = EXTERNAL

- ~ **SKIN**- epithelial tissues; flat with tight junctions protective barrier
- ~ **MUCOUS MEMBRANES**- mucous; mouth, nose, anus openings
- ~ **CILIA** line respiratory tract to sweep out invaders
- ~ **MUCUS** traps invaders
- ~ **SECRETIONS**
  - **SEBACEOUS (OIL) GLANDS - SEBUM** trap dust/particles
  - **SWEAT GLANDS** - pH 3-5; acidity is antibacterial
  - **HYDROCHLORIC ACID** in stomach (pH 2) kills most germs in food
  - **LYSOZYME**- enzyme in **SALIVA/TEARS** that digests bacterial cell walls

#### 2. SECOND LINE OF DEFENSE - INTERNAL

LEUKOCYTES (PHAGOCYTIC CELLS) = WBC's - engulf & digest invading bacteria

also destroy any damaged WBC/tissue = **PUS**

- ~ **NEUTROPHILS**- 60-70% major eaters
- ~ **MACROPHAGES** -" BIG" phagocytic cells
- ~ **EOSINOPHILS**- increase with infection by multicellular parasites; too big to eat;  
attach and release chemicals to kill parasites
- ~ **DENDRITIC cells**- have lots of long pseudopoda  
stimulate **ACQUIRED IMMUNITY** (B & T cells)

ANTIMICROBIAL PROTEINS part of complement system

- ~ **COMPLEMENT PROTEINS**- lyse cells; trigger **INFLAMMATION** (red, swelling, fever, pain)
- ~ **INTERFERON** response to viral infections;  
quarantines/protects nearby healthy cells from getting infected;  
activates macrophages to come and eat infected cells

INFLAMMATORY RESPONSE (Heat; swollen; fever; red; pain)

Due to increased blood flow to area to bring more immune cells;  
response to chemicals in damaged area

- \* **HISTAMINE** released by **MAST CELLS**; dilates BV's make them more leaky;  
brings more blood to infected area; plasma leaks into tissues

Take **ANTI HISTAMINE** counteracts **HISTAMINE** when you have a cold/runny nose

- \* **CHEMOKINES**- chemical signals call up macrophages

## NATURAL KILLER CELLS (NKC)

viruses & cancer cells not for bacteria

**TRIGGER APOPTOSIS**- cell death in infected cells

SPECIFIC ACQUIRED IMMUNITY - gain ability over time

### THIRD LINE OF DEFENSE

1. **HUMORAL IMMUNE RESPONSE (PLASMA CELLS)**- important in **BACTERIAL** infections

**B LYMPHOCYTES (B cells)** make **ANTIBODIES IMMUNOGLOBULINS (proteins)**

Antibodies weaken pathogens and mark for phagocytic cells to "eat"

2. **CELL-MEDIATED IMMUNE RESPONSE**- important in **VIRUSES, CANCER, TRANSPLANTS**

- Uses **T LYMPHOCYTES (T cells)**

- Made in bone marrow; become T cells in thymus

1. **CYTOTOXIC (KILLER) T CELLS**

recognize protein antigens on surface of virus infected cells; release chemicals

- **PERFORINS**- make holes in infected cells; water rushes in ;cells burst

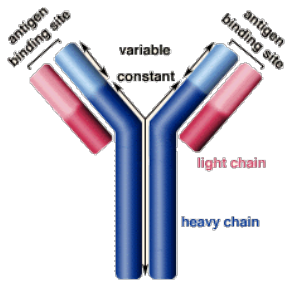
- **GRANZYMES**- enzymes that cut up infected host cell DNA

2. **HELPER T CELLS**- activate B cells and Killer T cells

3. **SUPPRESSOR CELLS**- maintain immune system homeostasis; tolerance to self-antigens

**ANTIBODIES** - body makes millions of different antibodies

- made of 2 heavy chains and 2 light chains-



- all similar except for ends of Y where antigen attaches

- antigen specific- fit like lock and key; "remember intron/exon editing"

- released into blood by B Cells;

- each cell only makes one specific type of antibody

- when antigen is recognized; cell reproduces rapidly in make more antibodies

Attachment of antibody to antigen releases

### **COMPLEMENT PROTEINS**

Circulate in blood

Activated by antibodies binding to **ANTIGENS**

Punch holes in cell walls of bacteria so they leak and die

**MEMORY CELLS**- created by exposure of B and T cells to antigens  
"Remembering" the antigen increases speed of response if exposed again

**ANAPHYLACTIC SHOCK-**

swelling & shortness of breath lead to shut down of body systems

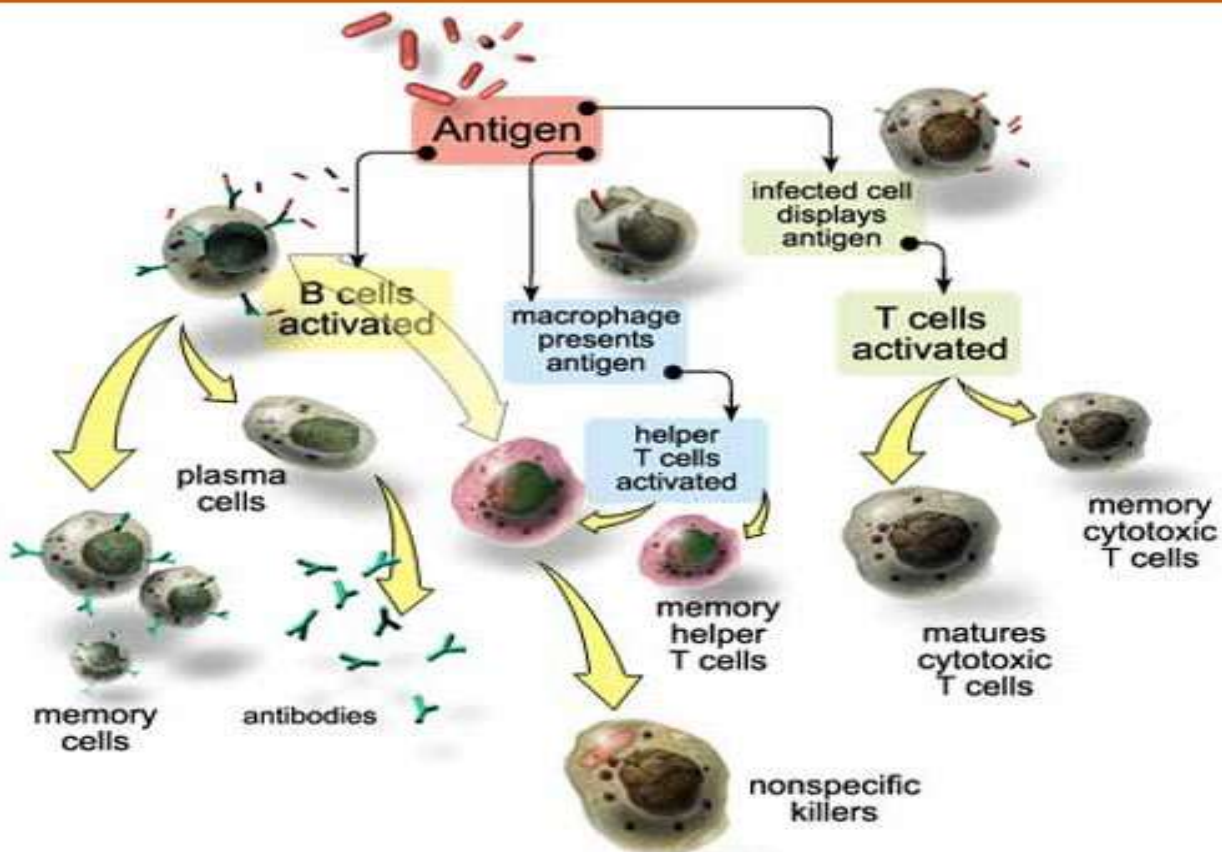
1<sup>st</sup> exposure-makes Ig E antibodies

Stick to mast cells which make allergy inducing chemicals (HISTAMINE)

2<sup>nd</sup> exposure- antigen attaches to IgE-mast cells causing them to release HISTAMINE

Treat with **ADRENALINE**

## Immune system cells



(Source: the Human Immune Response System [www.uta.edu/chagas/images/immunSys.jpg](http://www.uta.edu/chagas/images/immunSys.jpg))

<p><u>ACTIVE IMMUNITY</u></p> <p>Make own antibodies; longer lasting</p> <p>NATURAL</p> <ul style="list-style-type: none"> <li>exposed to pathogens</li> <li>create own immune response</li> <li>produce own antibodies</li> </ul> <p>ARTIFICIAL</p> <p>VACCINES/IMMUNIZATIONS</p> <ul style="list-style-type: none"> <li>increase immunity by exposure to weakened/killed antigen</li> <li>memory cells remember</li> </ul>	<p><u>PASSIVE IMMUNITY</u></p> <p>Antibodies come from another source don't last forever</p> <p>NATURAL</p> <ul style="list-style-type: none"> <li>Mother passes antibodies to fetus via placenta OR breast milk</li> </ul> <p>ARTIFICIAL</p> <ul style="list-style-type: none"> <li>snake bite produces immune response/shock</li> <li>Anti-venom made by injecting animals with venom</li> <li>Animals (horses) make antibodies to venom</li> </ul>
--	---