Immune system

Innate immunity

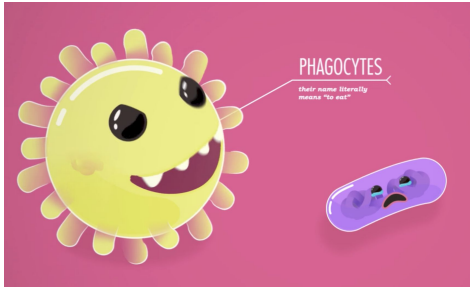
1

Barriers:

- Skin (epidermis, dentritic cells (eat pathogens), dermis)
- Sweat = enzyme lysosome, antimicrobial peptide, sebum oil
- Mucous membrane (packed cells, sticky)
- Microbial antagonism
- Antimicrobial lysozyme = tears, saliva

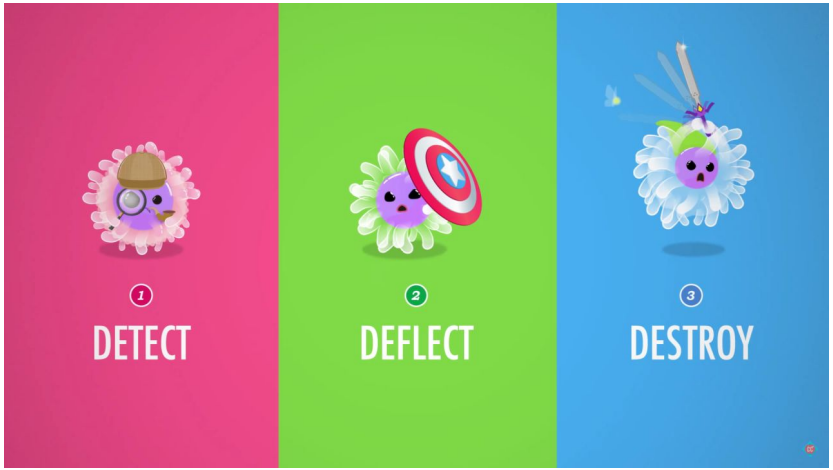
Phagocytes

- Macrophils
- Neutrophils
- Eosinophils



Extracellular killing

- Eosinophils
- NK lymphocytes



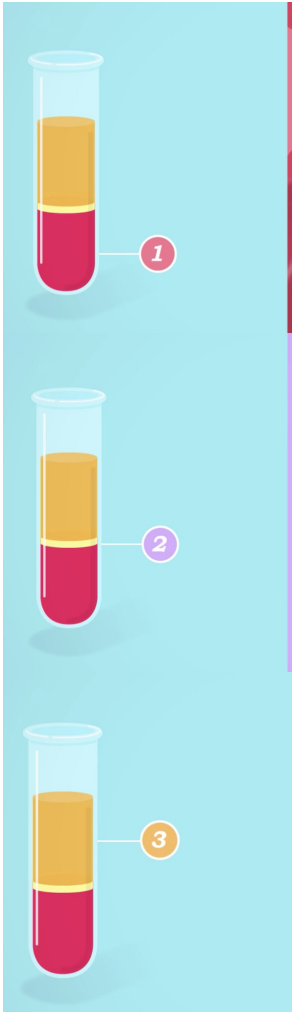
PLASMA

Gases
Proteins
Hormones
Electrolytes

BLOOD

WHOLE BLOOD

formed elements
water
dissolved molecules



ERYTHROCYTES

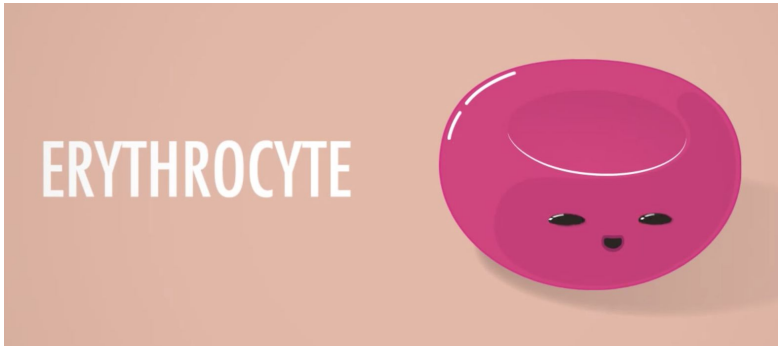
- *red blood cells*
- *carry oxygen and carbon dioxide*
- *make up 45% of your total blood volume*

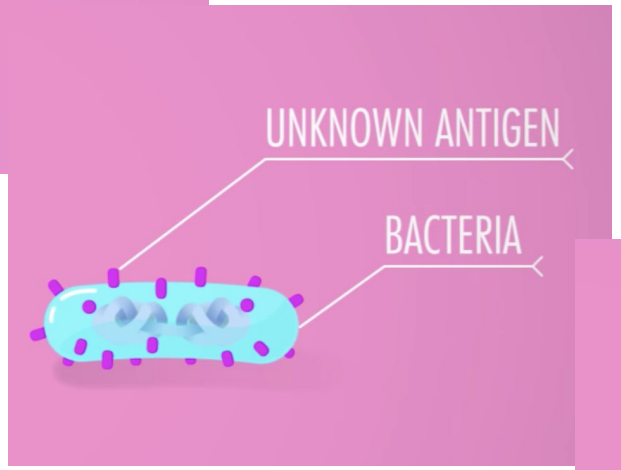
BUFFY COAT

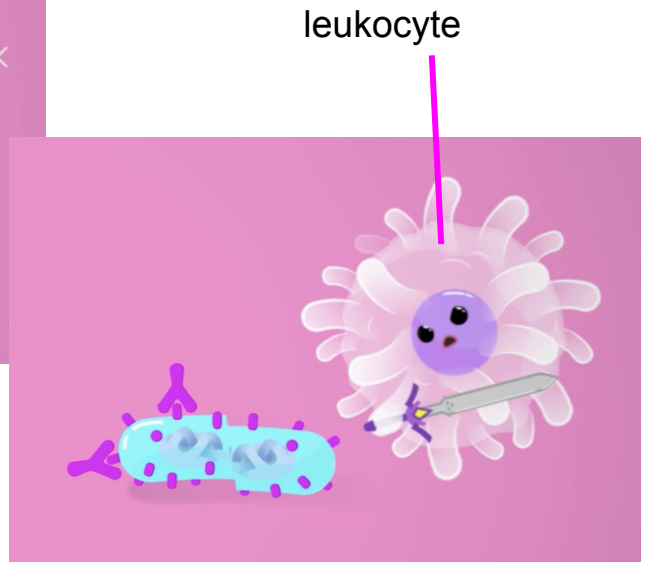
PLASMA

- *about 55 percent of your blood volume*

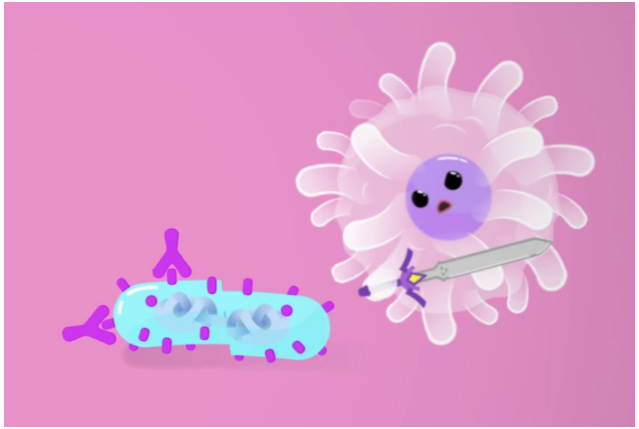
YOUR ANTIGEN


ERYTHROCYTE


UNKNOWN ANTIGEN
BACTERIA


leukocyte

Leukocytes (WBC)

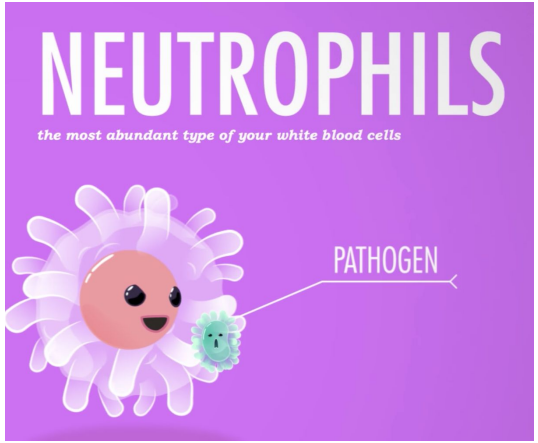


Granulocytes

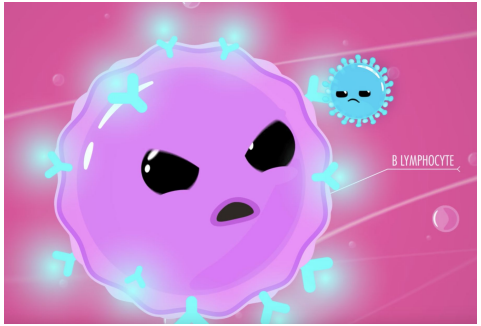
Basophils release histamine (blue dye)

Eosinophils fight worms & phagocytize (red/orange)

Neutrophils phagocytize pathogens (lilac dye)



neutrophils make **extracellular fiber traps** (NETs) that **bind & kill bacteria**



Leukocytes

Agranulocytes -

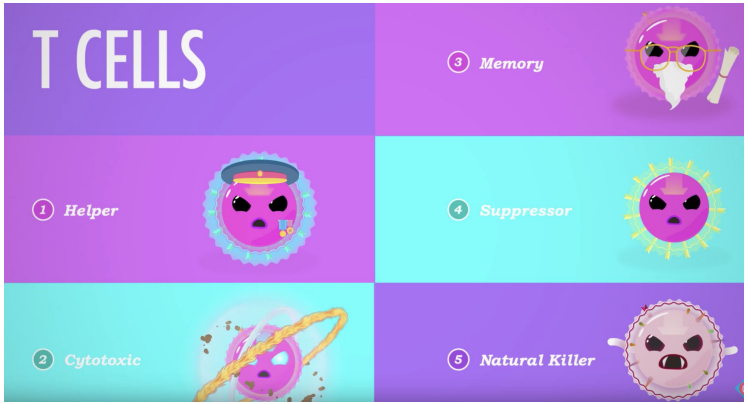
Lymphocytes

B cells

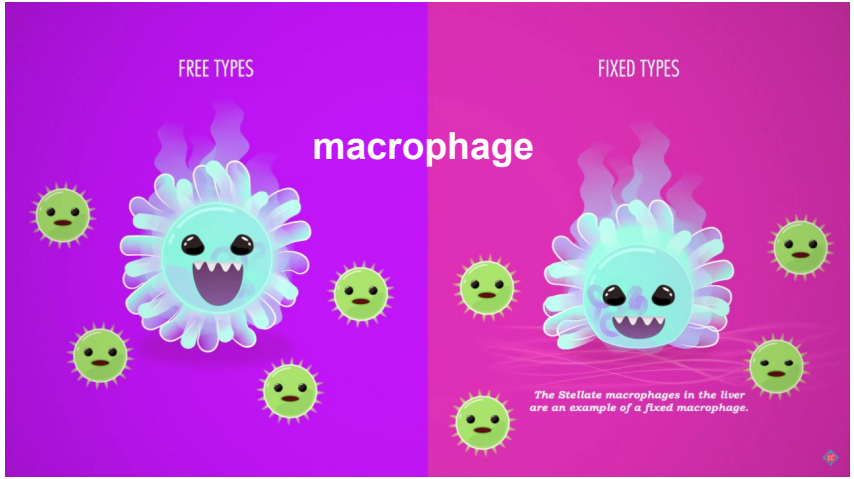
antibody immune response

T cells

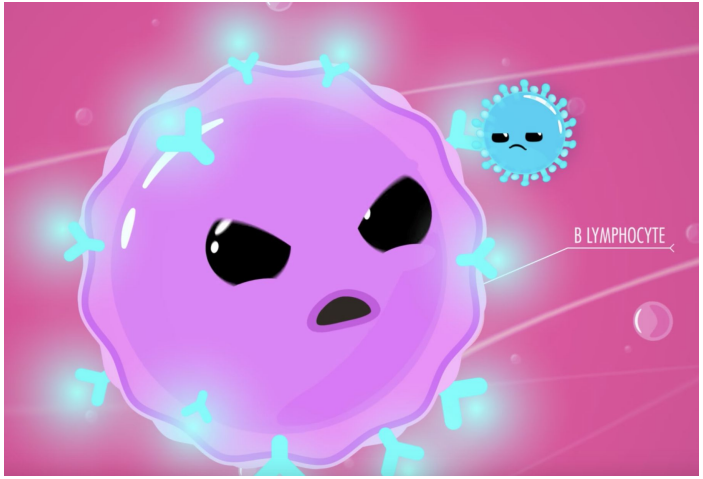
thymus, regulate immune response
Fight endogenous antigens (blood+lymph)
TLR cell receptors on cytoplasm membrane

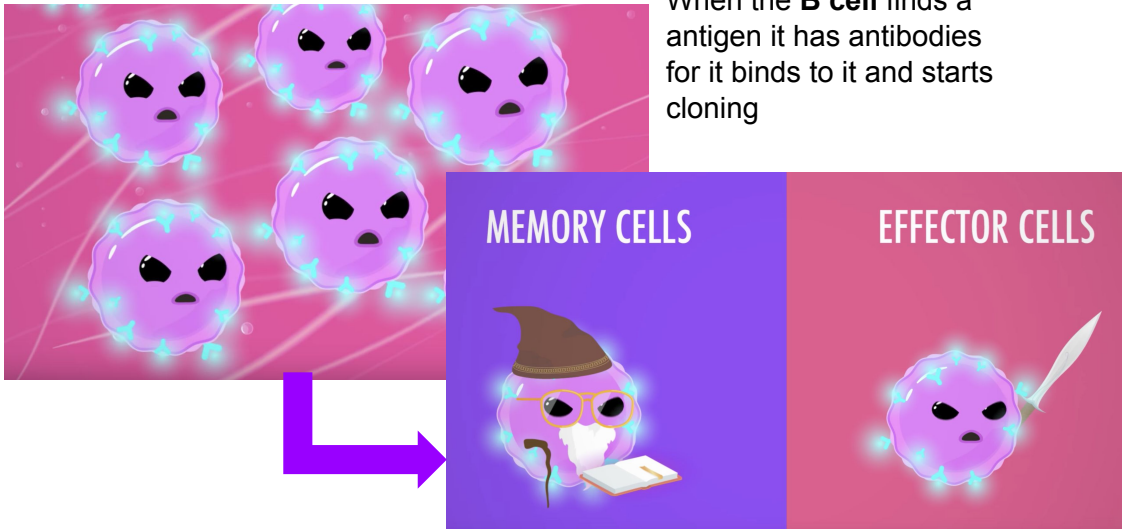


Monocytes become macrophages

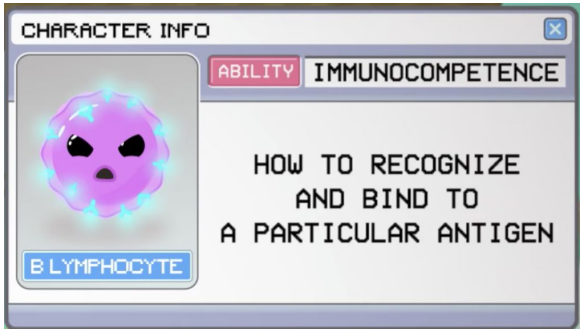


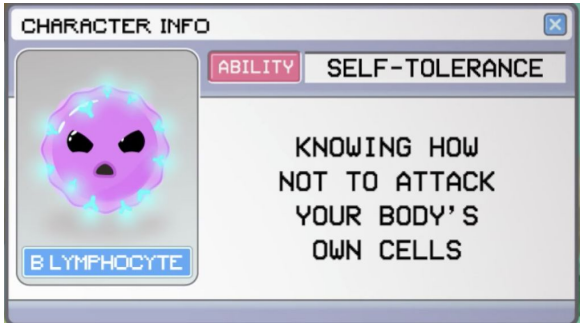
B cell lymphocyte

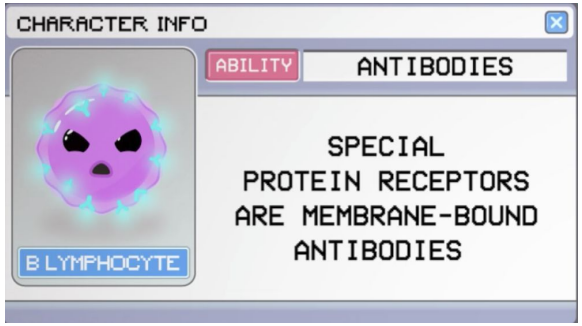


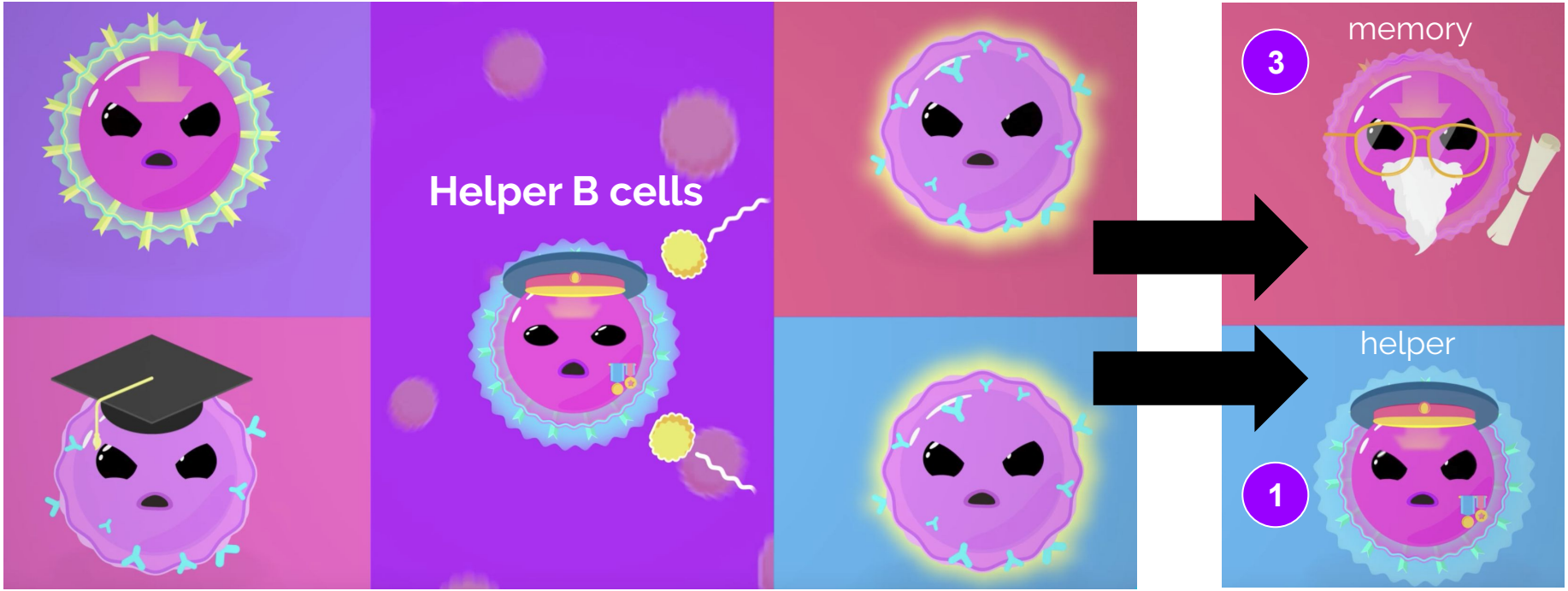


When the **B cell** finds a antigen it has antibodies for it binds to it and starts cloning

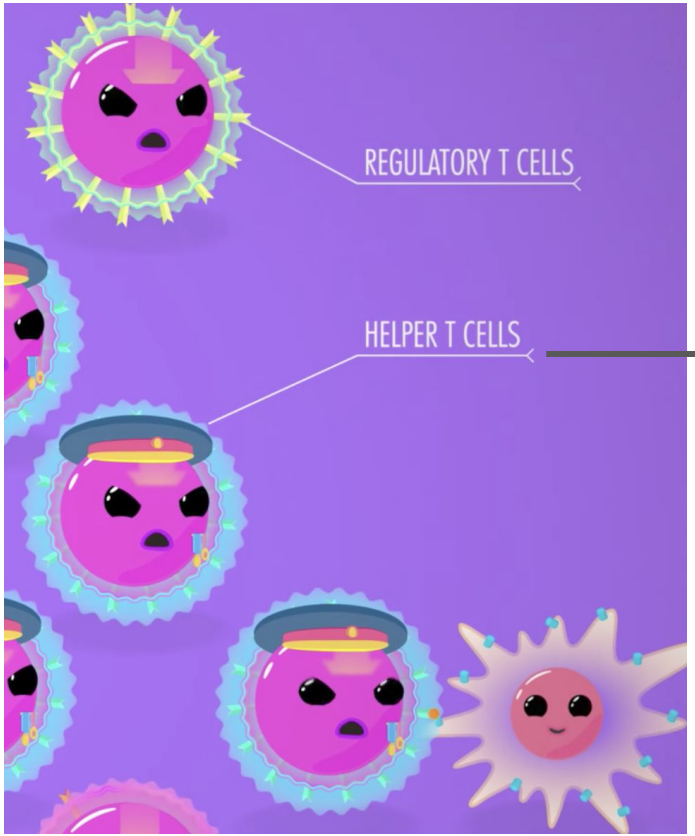


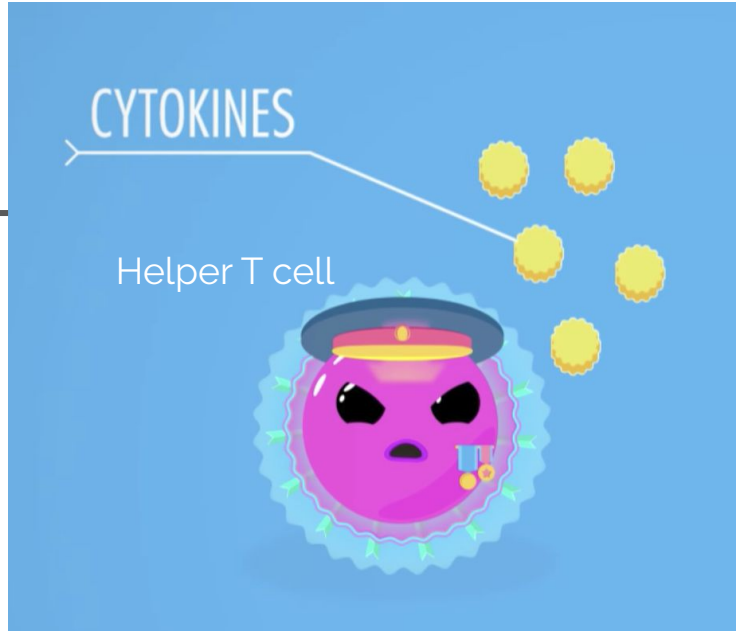






B cells will ingest pathogen, then wait for inspection from a Helper B cell. If it binds to the B cell it releases cytokines





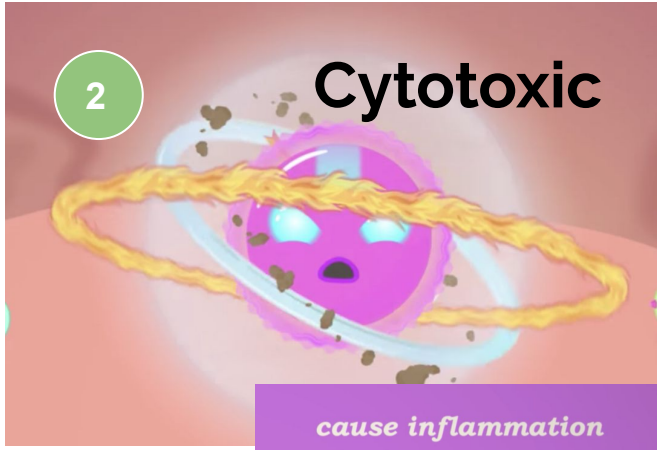
B cells will make and release cytokines

T cell lymphocyte

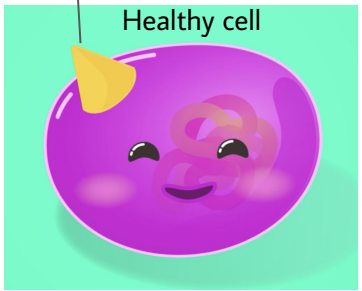
Memory cells

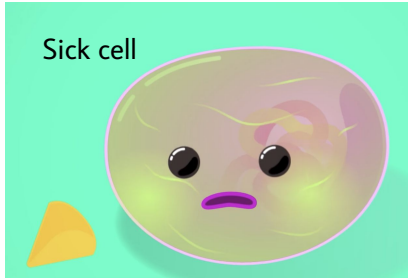
Natural Killer cells

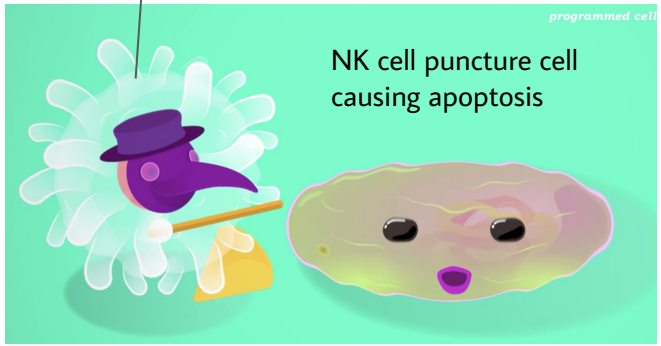
Cytotoxic



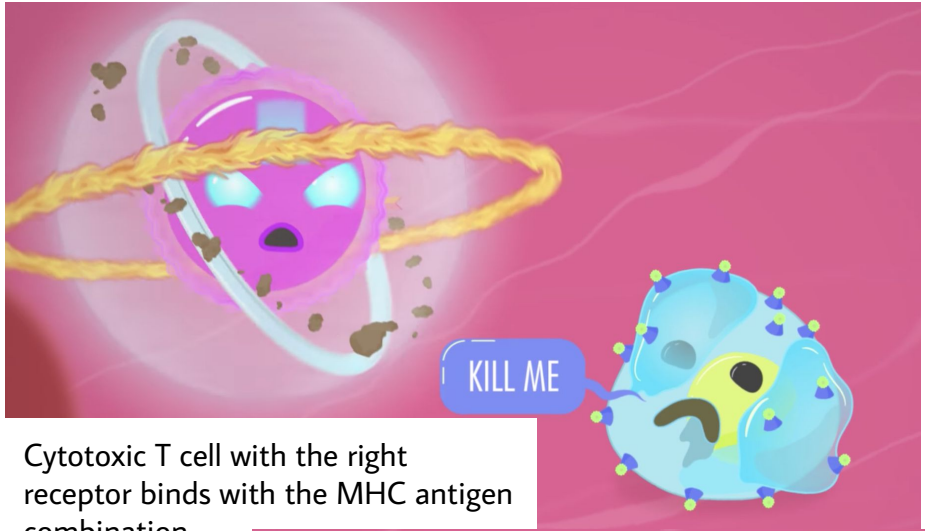
- *cause inflammation*
- *activate macrophages*
- *get other T cells fired up*
- *regulate much of the immune response*







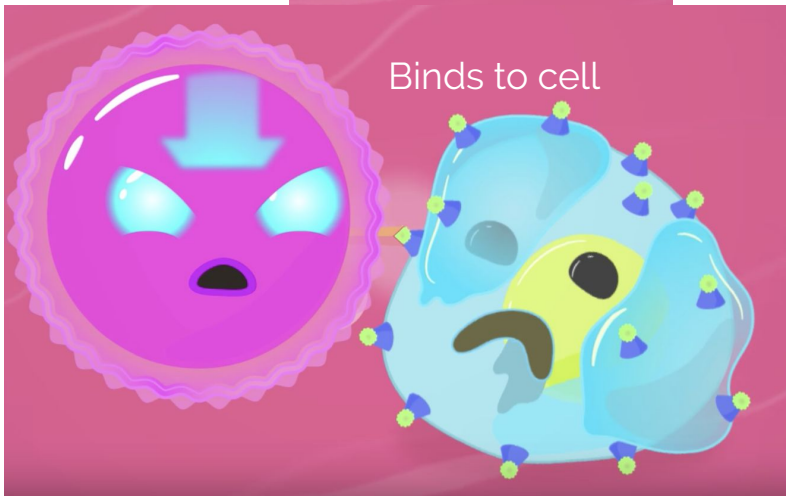
Cytotoxic T cell

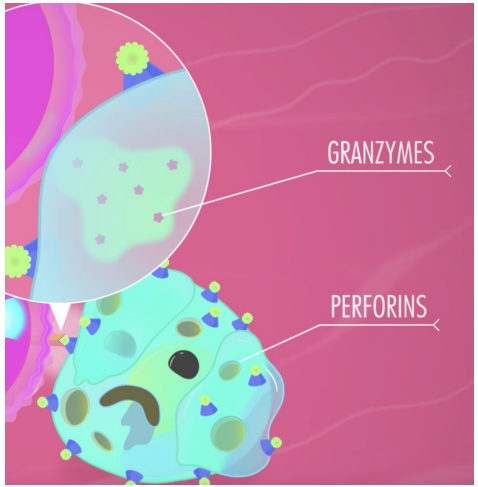


Cytotoxic T cell with the right receptor binds with the MHC antigen combination

Activation

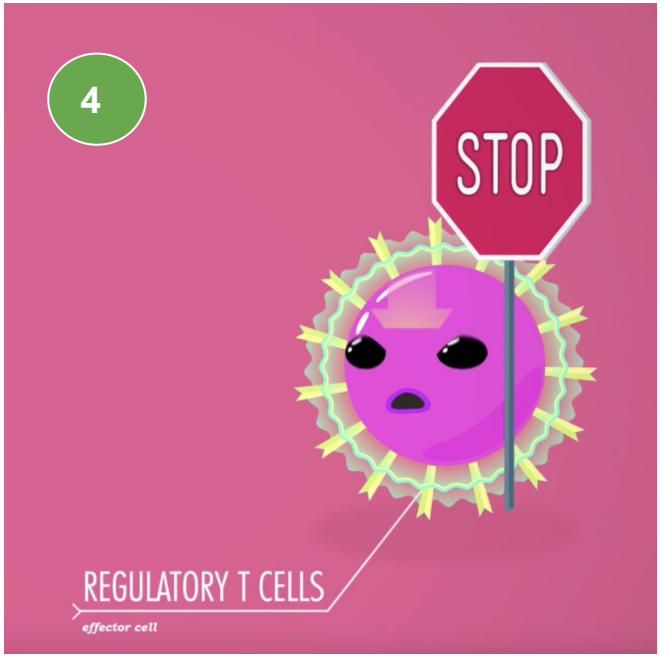
Antigen presentation
Helper T cell differentiation
Clonal expansion
self -stimulation



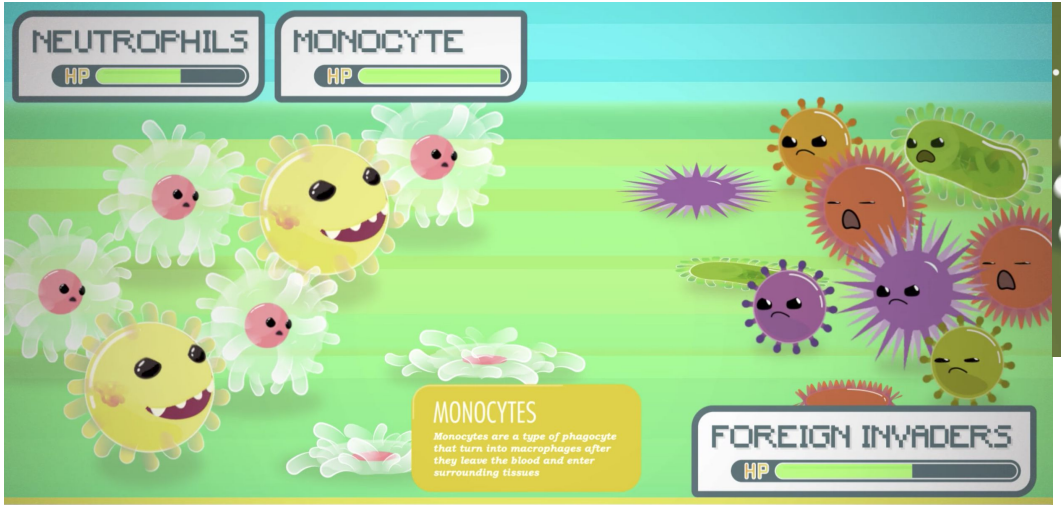


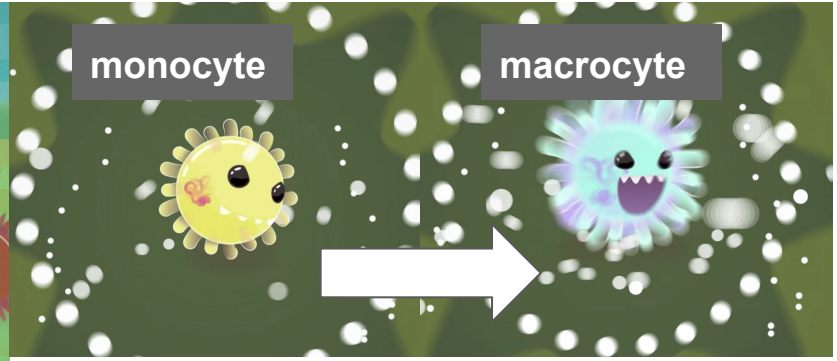
Releases granzymes and perforins to kill cell or use CD95 pathway

Regulatory T cell



Tells cells to stand down from attacking





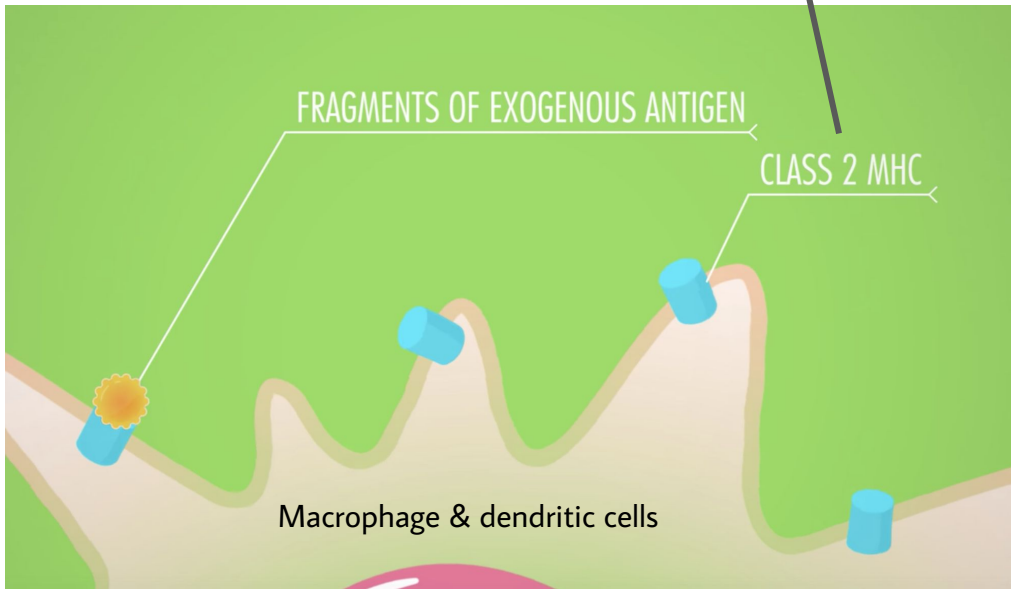
Leukocytes

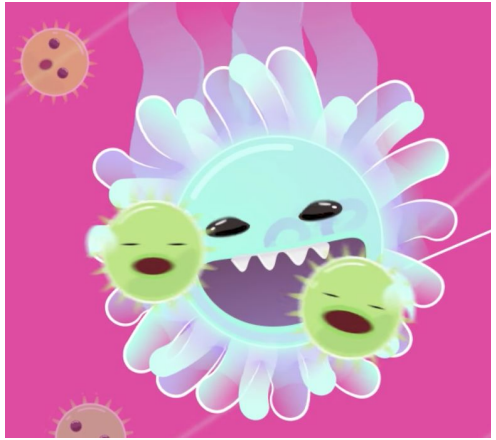
If **neutrophils** and **macrophage** get outnumbered they call for a **fever**

Major Histocompatibility Complex

MHC antigens bind to all cells except RBC

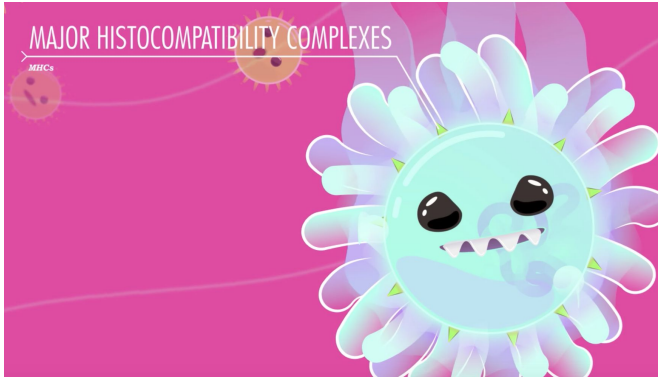
antigen presenting cells (APC)

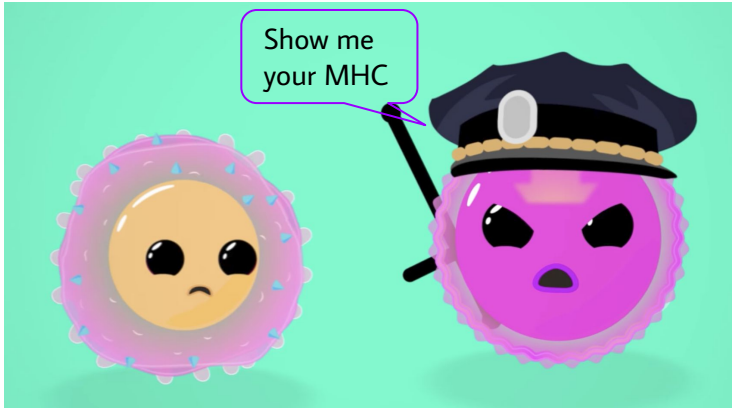




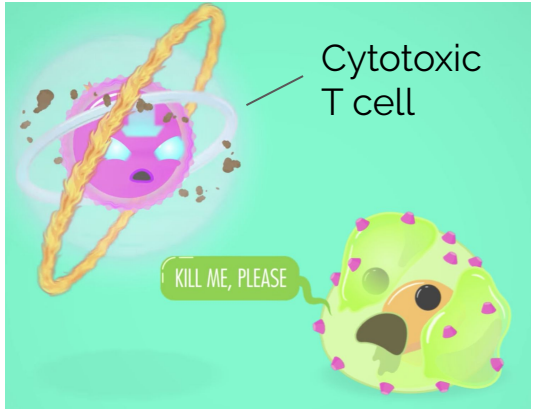
Macrophage

Eats pathogen and shows MHC



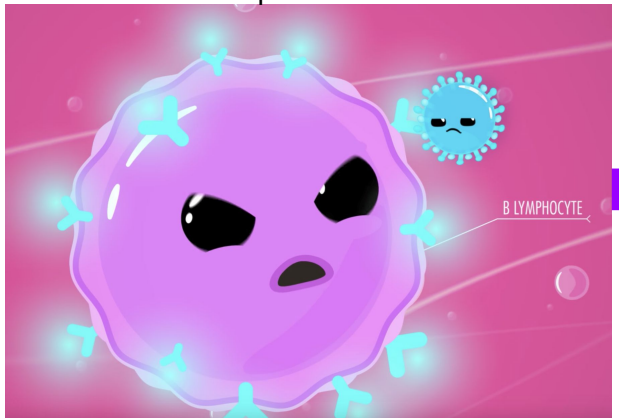


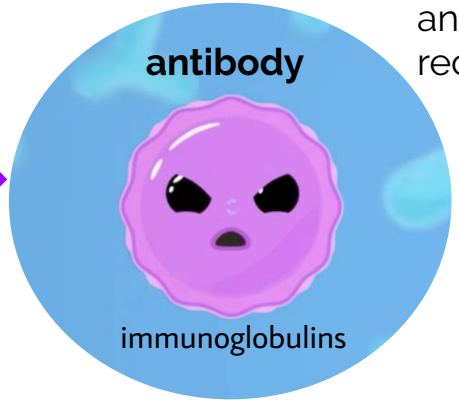
If the MHC is wrong or the cell is sick Cytotoxic T cell gets called



Adaptive immunity

B cells make protein antibodies





Antibodies recognizes shapes and **B cell receptors (BCR)** recognize only 1 epitope

Types

- **IgM** *1st made*, start of an infection
- **IgG** most common
- **IgA** body secretions
- **IgE** parasitic infections & allergies
- **IgD** function not known

Function

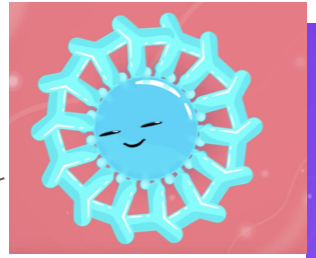
Neutralization

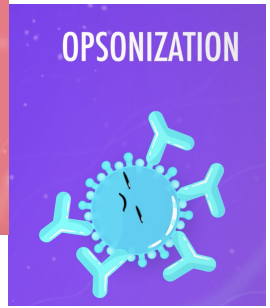
Activate complement system & inflammation

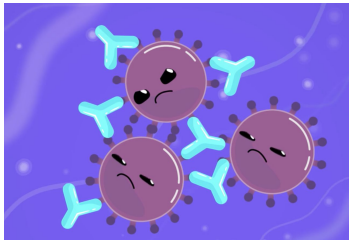
Opsonization

Agglutination

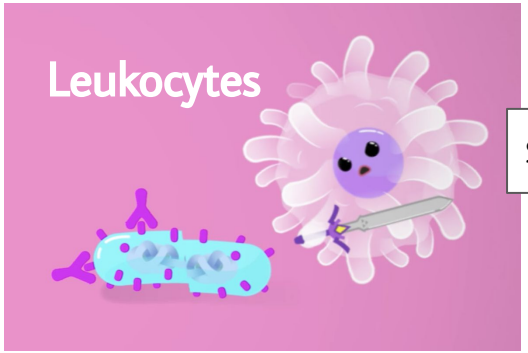
Antibody dependent cell cytotoxicity (ADCC)



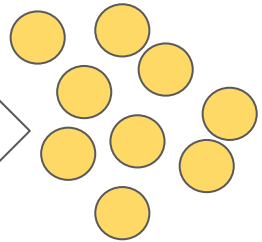




Immune response cytokines

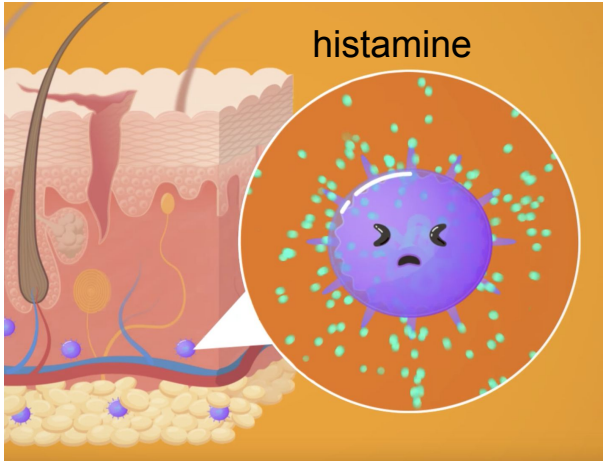


Secrete cytokines



Cytokine network

Interleukin (ILs) = signal
Interferons (IFNs) = antiviral proteins
Growth factors = stimulate cell division
Chemokines = signal leukocytes to move
Tumor necrosis factor (TNF) = (macrophage & T cell secreted) kill tumor cells & regulates immune response


histamine