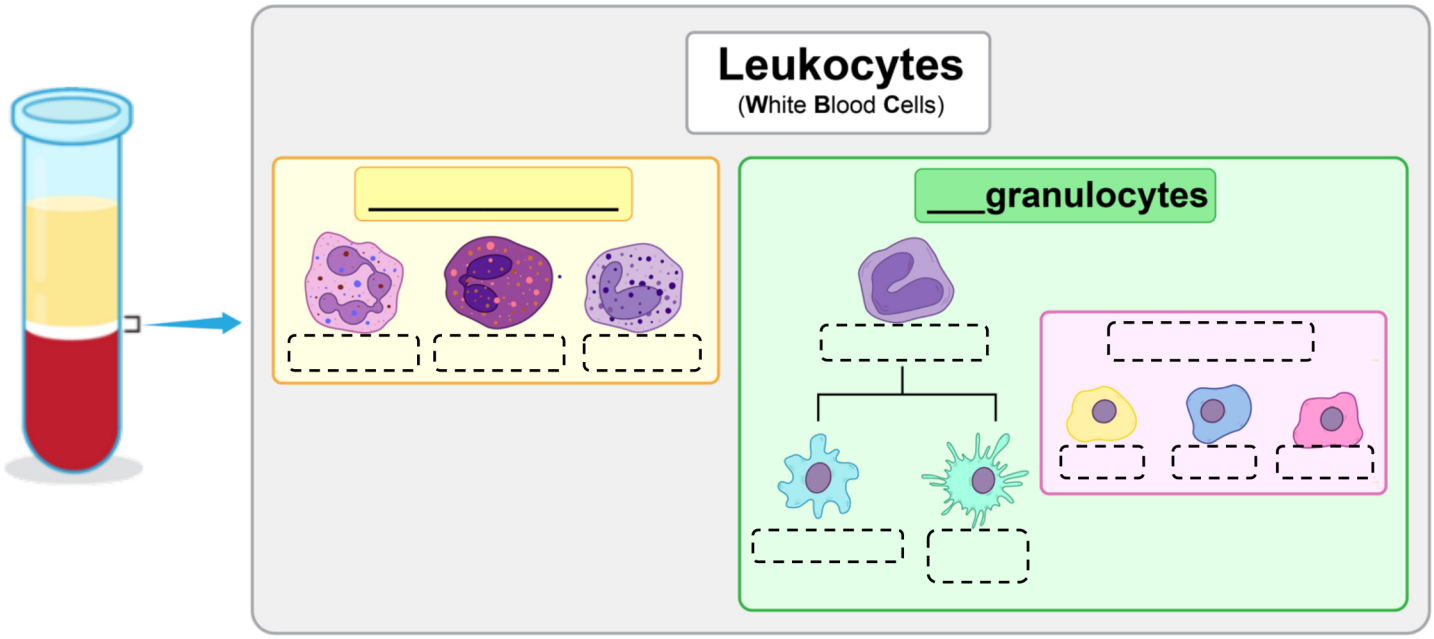
TOPIC: LEUKOCYTES

Introduction to Leukocytes

- **Leukocytes (White Blood Cells, WBCs)**: defend body against _____.
  - Unlike RBCs, WBCs are _____ confined to blood; many use bloodstream to travel where they are needed.
- Leukocytes can be broadly categorized into _____ groups:
  1. **Granulocytes**: contain cytoplasmic _____ that are *easily* observed under a microscope.
  2. **Agranulocytes**: do _____ contain easily visible cytoplasmic granules



EXAMPLE

Which of the following statements about erythrocytes and leukocytes is false?

a) Leukocytes are significantly larger than erythrocytes.

b) Leukocytes and erythrocytes are both confined to the bloodstream during normal function.

c) Erythrocytes' primary function is transport, while leukocytes' primary function is protection.

d) All of the above are true.

PRACTICE

What differentiates granulocytes from agranulocytes?

a) Granulocytes contain cytoplasmic granules, but agranulocytes do not.

b) Granulocytes contain cytoplasmic granules that can be easily visualized under a microscope after staining.

c) Granulocytes are larger.

d) Granulocytes are smaller.

TOPIC: LEUKOCYTES

●**Granulocytes:** white blood cells with visible cytoplasmic _____.

□ **Granules:** contain compounds used for protective functions & are visible under a light microscope.

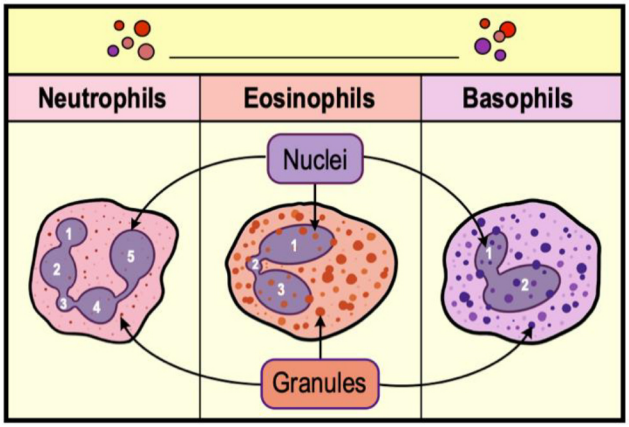
●There are _____ types of granulocytes named based on the staining properties of their granules:

1) **Neutrophils:** have a nucleus with 5 lobes & small granules which do _____ stain well.

□ Also known as: **P**oly**M**orphonuclear **N**eutrophils (_____s).

2) **Eosinophils:** have 2-3 lobes in the nucleus & large granules that stain a _____/orange color.

3) **Basophils:** have a two-lobed nucleus & large granules that stain a dark _____/purple color.



Neutrophils

●**Neutrophils** are the most _____ type of leukocyte in the blood (can make up to 70% of all leukocytes).

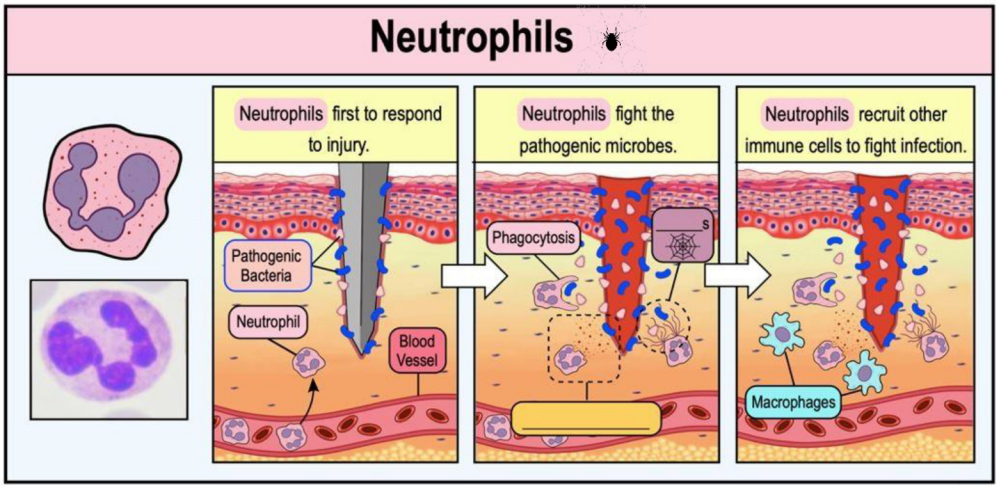
□ Migrate to different locations via _____stream & are often *first* to respond to infection or tissue damage.

□ Granules contain variety of defensins & hydrolytic enzymes that _____ microbes.

□ Granules can be _____ from the cell (**degranulation**) or used to destroy microbes during *phagocytosis*.

□ **Phagocytosis:** process of _____ & digesting material including invading microbes (cell "eating").

□ Can also release neutrophil extracellular traps (NETs) or webs of chromatin that _____ infecting microbes.



TOPIC: LEUKOCYTES

PRACTICE: Which granulocyte is the first to respond to an infection, has hydrolytic enzymes in its granules, and possesses the ability of phagocytosis?

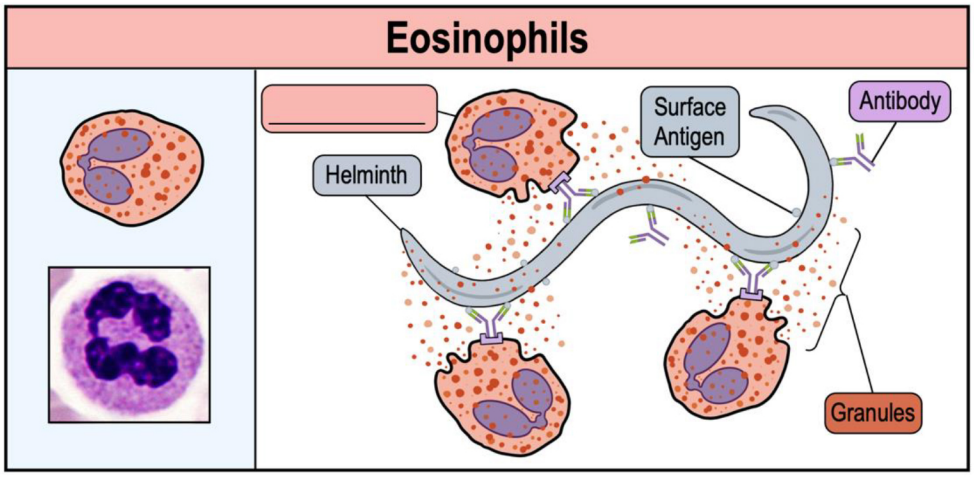
a) Basophil.
b) Eosinophil.
c) Neutrophil.
d) Macrophage.

Eosinophils

●Primary role of **Eosinophils** is to protect against parasitic _____ (helminths).

□ Granules have antimicrobial substances that bind parasites & enzymes that disrupt membrane permeability.

□ Can also cause some symptoms associated with _____.



Basophils

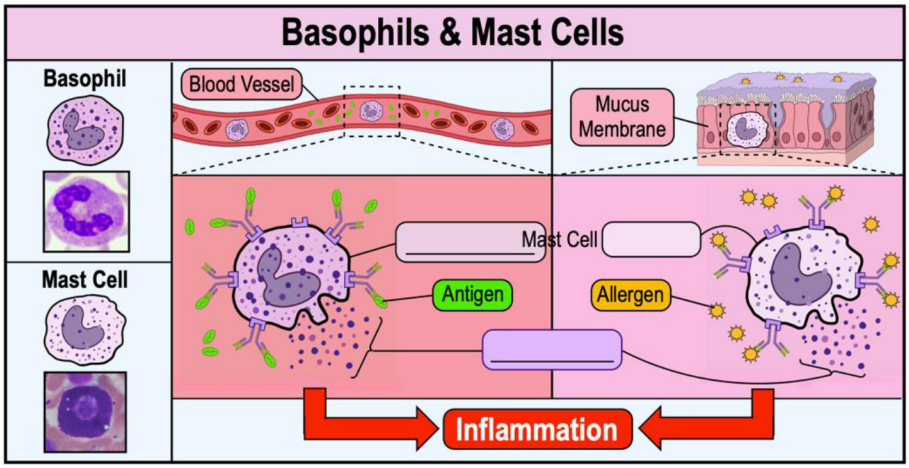
●**Basophils:** are also involved in allergic reactions & inflammation response during infection.

□ Produce _____ that are released during inflammation to increase *capillary permeability*.

□ Allows other defense cells to easily _____ the bloodstream & enter an infected area of the host.

□ _____ **Cells:** similar in function to basophils but are found *inside tissues* rather than circulating the blood.

□ Detects tissue damage, *degranulates* to release *histamine*, which induces *inflammation*.



TOPIC: LEUKOCYTES

PRACTICE: Which of the following is a phagocytic cell found in the human body?

a) Eosinophil.
b) Neutrophil.
c) Basophil.
d) T cell.

PRACTICE: Which of the following answers are characteristics or roles of granulocytes?

a) Release of hydrolytic enzymes that damage bacterial cell membranes.
b) Production and release of histamines which increases capillary permeability.
c) Release antimicrobial substances that damage the membranes of parasites.
d) Phagocytose invading microorganisms.
e) All of the above.

PRACTICE: White blood cells are referred to as _____.

a) Platelets.
b) Erythrocytes.
c) Leukocytes.
d) Megakaryocytes.

PRACTICE: Two immune cells have very similar functions. Both immune cells release histamine and induce inflammation. However, _____ cells reside in specific tissues, while _____ cells travel through the blood stream.

a) Mast cells; Basophil cells.
b) Basophil cells; Neutrophil cells.
c) Granulocyte cells; Basophil cells.
d) Eosinophil cells; Dendritic cells.

TOPIC: LEUKOCYTES

PRACTICE: In type I allergic reactions, antibodies are produced and bind to:

a) Mast cells.
b) Neutrophils.
c) Eosinophils.
d) Monocytes.

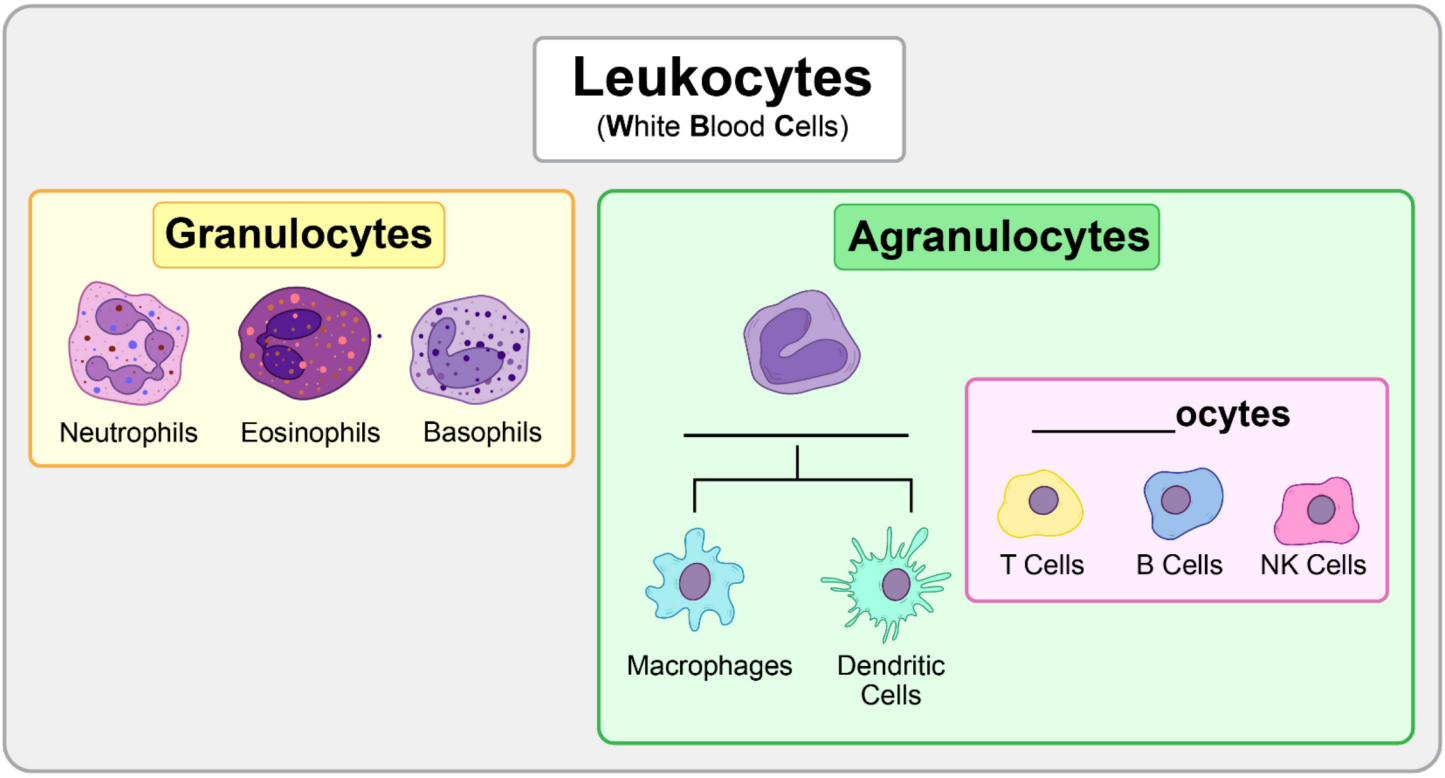
PRACTICE: Granulocytes:

a) Travel through the lymphatic system.
b) Are the most numerous leukocyte in circulation.
c) Develop in the thymus.
d) Do not contain distinct granules in their cytoplasm.

TOPIC: LEUKOCYTES

Agranulocytes

- **Agranulocytes**: leukocytes with cytoplasmic granules that are _____ visible under a light microscope.
- Agranulocytes include:
  1. _____: circulate the bloodstream & can develop into macrophages or dendritic cells.
  2. **Lymphocytes**: includes B & T cells, which are involved in _____ immunity (covered in later videos).



TOPIC: LEUKOCYTES

Monocytes

●Monocytes develop into one of _____ types of *phagocytic cells*:

1) Macrophages: phagocytic, sentinel cells that respond *directly* to an infection & can alert other host defenses.

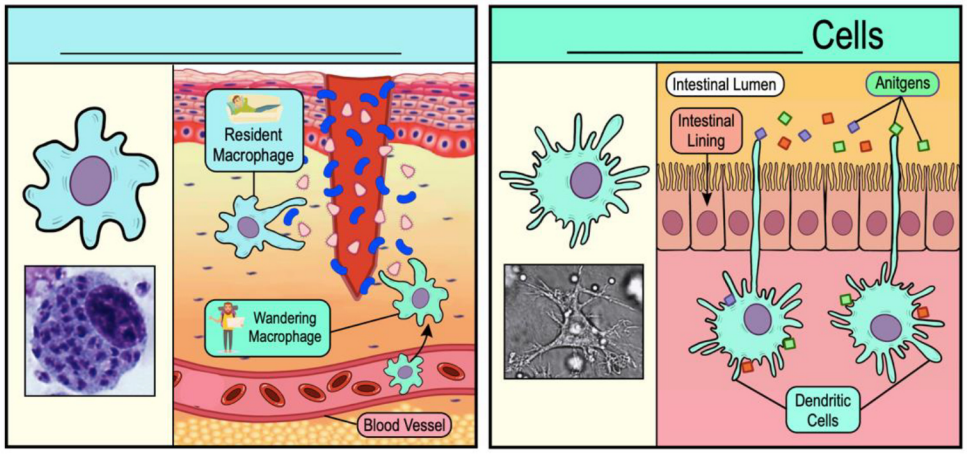
□ _____ **Macrophages:** *reside* permanently in specific tissues (remain *stationary* in tissues).

□ **Wandering Macrophages**: _____ through the blood to *other* sites of infection.

□ **Giant Cells:** macrophages fused together to increase their destructive ability.

2) Dendritic Cells: sentinel cells with long appendages that reside in tissues & alert/initiate *adaptive immunity*.

□ _____ pathogens in tissues, then present them to cells of the *adaptive immune system*.



PRACTICE: All of the following are major differences between macrophages & neutrophils except which of these answers?

a) Macrophages can perform phagocytosis while neutrophils cannot.

b) Macrophages kill microbes by "eating" them. Neutrophils kill microbes with hydrolytic enzymes and/or phagocytosis.

c) Neutrophils circulate the bloodstream while resident macrophages reside in tissues.

d) Neutrophils are granulocytes while macrophages are agranulocytes.

PRACTICE: Monocytes can differentiate into which types of immune cells?

a) Basophils & macrophages.

b) Neutrophils & dendritic cells.

c) Macrophages & dendritic cells.

d) Mast cells & macrophages.

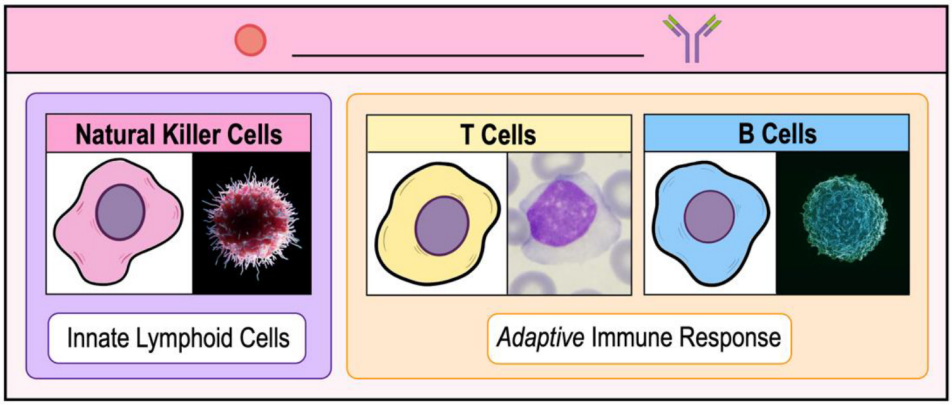
TOPIC: LEUKOCYTES

Introduction to Lymphocytes

●*Recall:* **Lymphocytes:** includes leukocytes involved in _____ *immunity* (covered in other videos).

□ 2 major groups of lymphocytes: 1) ____ **cells** & 2) ____ **cells**

□ Both respond to _____ antigens of invading microbes.



●HOWEVER, a group of lymphocytes (*innate lymphoid cells*) differ from B & T cells since they are part of *innate* immunity.

□ **Innate Lymphoid Cells (ILCs):** differ from B & T cells due to a _____ of specificity in antigen recognition.

□ An example of ILCs are **Natural Killer Cells (_____s)** that kill a variety of cell types.

PRACTICE: Why is a bone marrow transplant used to replace defective lymphocytes in a patient?

a) Bone marrow creates common myeloid progenitor cells which differentiate into lymphocytes.

b) Bone marrow creates monocytes which differentiate into lymphocytes.

c) Bone marrow creates hematopoietic stem cells which differentiate into all immune cells including lymphocytes.

TOPIC: LEUKOCYTES

PRACTICE: Which of the following immune cells is NOT a professional phagocyte?

a) NK cell.
b) Neutrophil.
c) Macrophage.
d) Dendritic cell.

PRACTICE: Which of the following are referred to as mononuclear phagocytes?

a) Lymphocytes and basophils.
b) Mast cells and eosinophils.
c) Basophils and eosinophils.
d) Monocytes and macrophages.