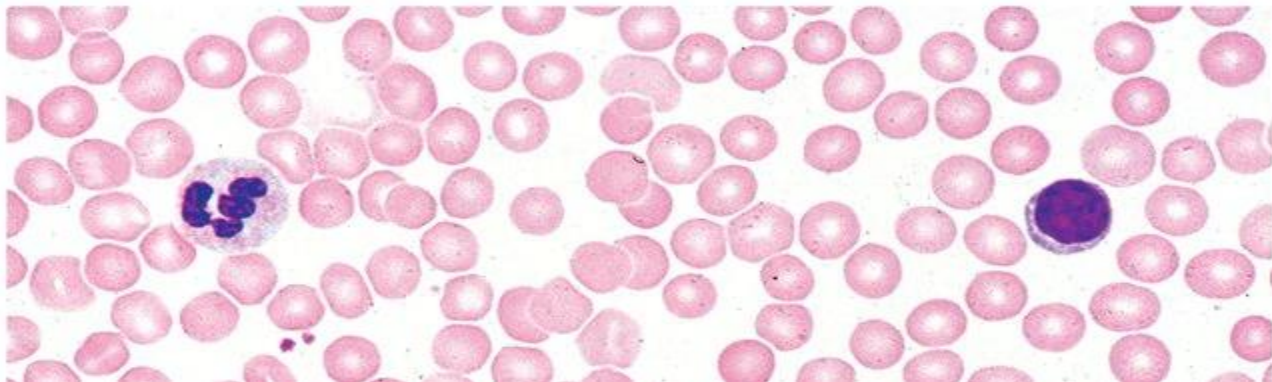


# 1/24/19 Bell Ringer:

- Please **COPY THE QUESTION** in your notebook and **date** it below your drawing from yesterday: THEN ANSWER IT IN WRITING IN YOUR NOTEBOOK FOR POINTS.

**What are the four parts of blood and what are their main functions?**



# Normal Parts of Blood

Monocyte



Neutrophil



Eosinophil



Basophil



Platelets



Macrophage

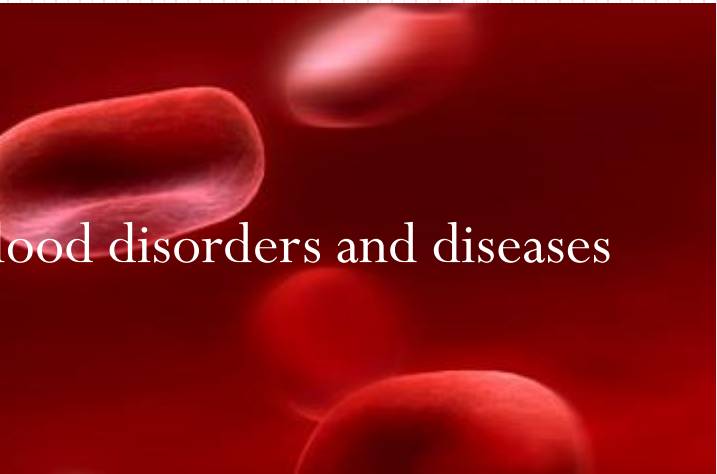


Erythrocyte



# Blood Disorders

**Hematology:** The study of blood disorders and diseases

A microscopic view of several red blood cells, which are biconcave discs, set against a dark red background. The cells are shown in various orientations, some appearing as bright red discs and others as more translucent, elongated shapes.

# Blood Basics

- 7-8% of human body weight is from blood
- Adults have 4.5-6 quarts of blood
- Blood is a highly specialized tissue composed of more than 4,000 different kinds of components!
- most important are red cells, white cells, platelets, and plasma
- **Functions:**
  - Brings oxygen and nutrients to our cells
  - Carries away carbon dioxide, ammonia, and other waste products
  - Supports immune system
  - Helps maintain a relatively constant body temperature
  - Clotting factors protect you from losing blood if injured

# Plasma

- Clear to yellow tinted liquid
- Mostly made of water (92+% H<sub>2</sub>O)
- Normally, 55% of our blood's volume
- It is likely that plasma contains some of **every protein produced by the body**--approximately 500 have been identified in human plasma so far.
- **Functions:**
  - Carries the red cells, white cells, and platelets
  - Keeps cells hydrated and takes away wastes
  - Carries the red cells, white cells, and platelets
  - Distributes sugar, fat, protein and salt throughout the body
- Blood Plasma is one of the “most important medications needed in basic health maintenance.”

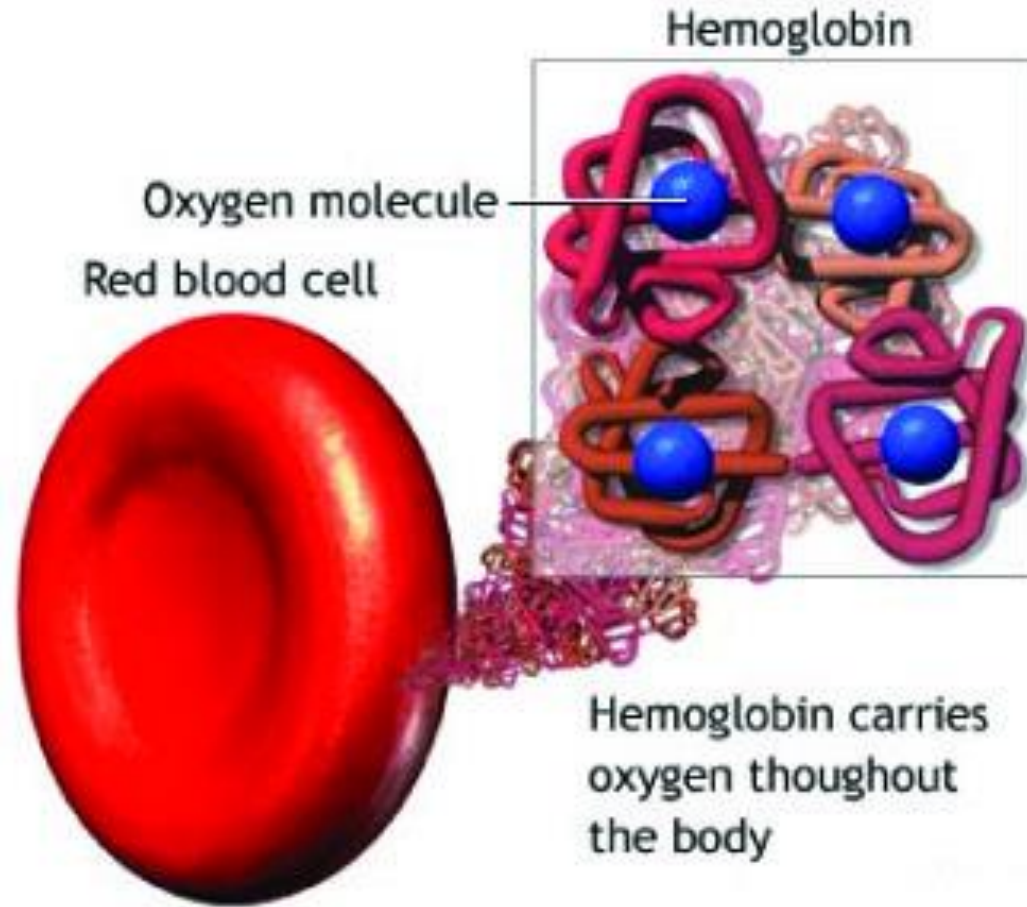


# Erythrocytes (Red Blood Cells or RBC's)



- Large microscopic cells without nuclei
- **40-50%** of the total blood volume.
- Produced continuously in our bone marrow from stem cells at a rate of about **2-3 million cells per second**
- **Hemoglobin** is a **protein molecule** that makes up 95% of a red cell. This is the part that transports Oxygen and CO<sub>2</sub>
- RBC's last about **3-4 months** before being removed and recycled in the bone marrow
- **Function:**
  - **Transports oxygen** from the lungs to all of the living tissues of the body and **carry away carbon dioxide**

# Hemoglobin Protein (27 million per RBC!)

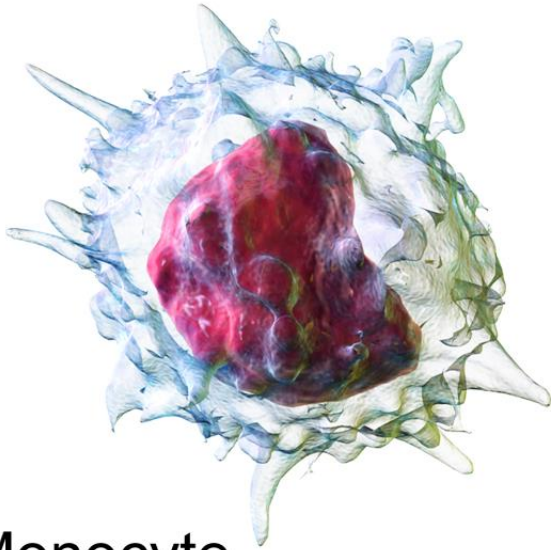


# Leukocytes (White Blood Cells or WBC's)

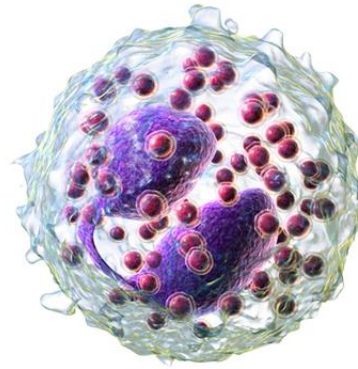
- Make up about **1% of blood** in healthy people.
- Leukocytes also occur elsewhere in the body (spleen, liver, and lymph glands)
- Most are produced in our **bone marrow** from the same kind of stem cells that produce red blood cells.
- Others are produced in the **thymus gland**
- Most WBC's only last **18-36 hours**
- **Functions:**
  - **Lymphocytes** are the first responders for our **immune system**. They seek out, identify, and bind to alien protein on bacteria, viruses, and fungi so that they can be removed
  - **Monocytes**, or **macrophages**, destroy the alien cells, dead or dying blood cells and foreign matter like dust



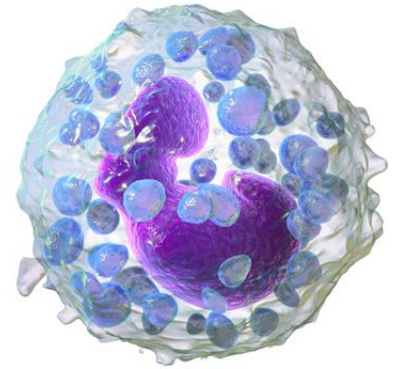




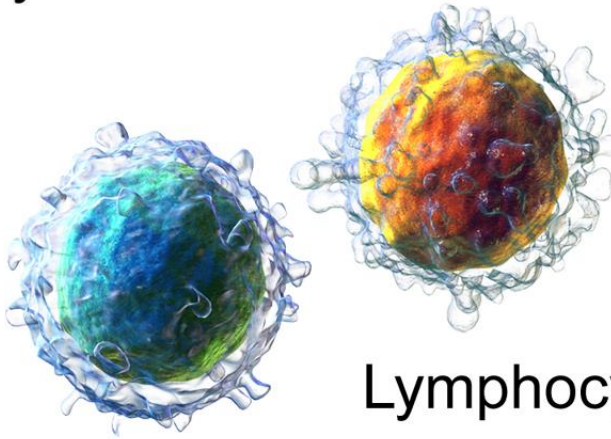
Monocyte



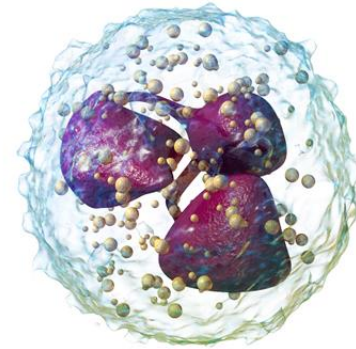
Eosinophil



Basophil


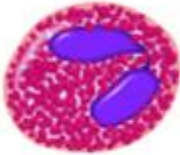
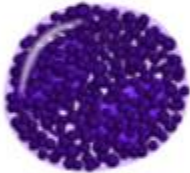

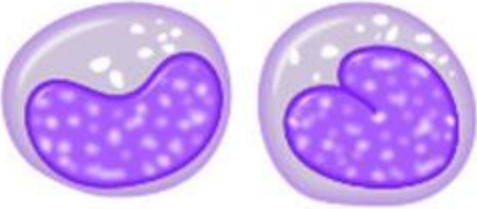


Lymphocytes

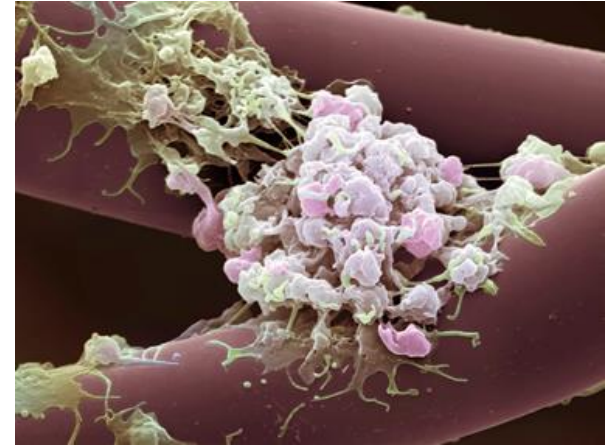


Neutrophil

# White Blood Cells

Subtype	Nucleus	Function	Example
Neutrophil	Multi-Lobed	Bacterial or fungal infection. These are the most common first responders to microbial infection.	
Eosinophil	Bi-Lobed	Parasitic infections and allergic reactions (inflammatory).	
Basophil	Bi/Tri-Lobed	Allergic and antigen response (releases histamine causing vasodilation).	
Lymphocyte	Deep Staining, Eccentric	Include B cells, CD4+ helper T cells, and CD8+ cytotoxic T cells. Operate primarily in the lymphatic system.	
Monocyte	Kidney Shaped	Phagocytosis of pathogens. Presentation of antigens to T cells. Eventually, they become tissue macrophages, which remove dead cell debris and attack microorganisms.	

# Thrombocytes (Platelets)



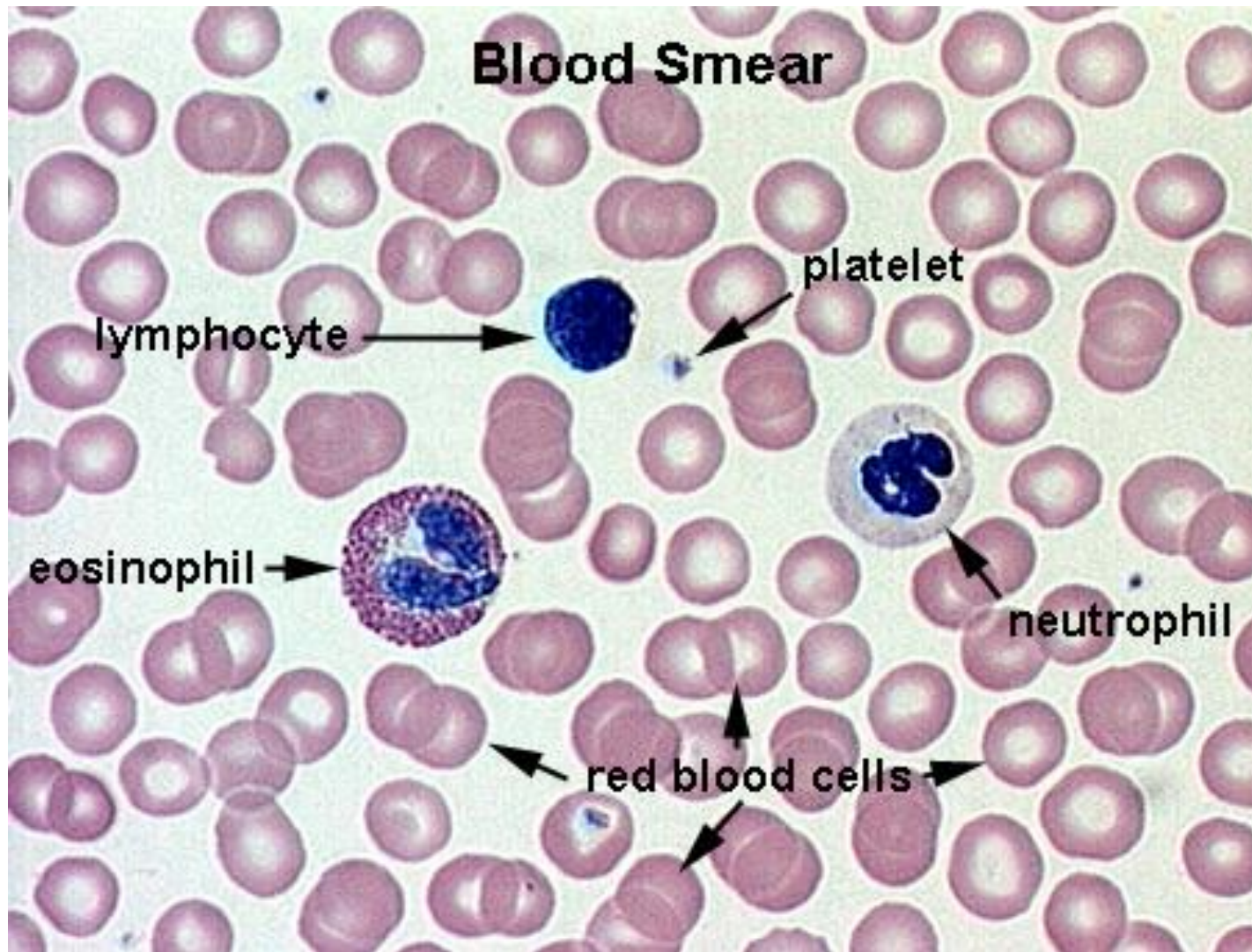
- **Cell fragments** with no nuclei
- About **1/3 the size of RBC's**
- They have a **lifespan of 9-10 days**
- Produced in **bone marrow** from stem cells
- The peak of platelet activation is in the morning.
- This is one of the main reasons that **strokes and heart attacks are more common in the morning.**
  
- **Functions:**
  - Work with **blood clotting chemicals** at the site of wounds
  - They adhere to the walls of blood vessels plugging the rupture in the vascular wall.
  - May also help fight infections by releasing **proteins that kill invading bacteria** and some other microorganisms

# Goals for Today:

- Finish part 1 and 2 of 3.1.1
- Note steps 16 asks you to write a comparison of Normal Blood and Anna's blood in your notebooks
- Answer the reflection question in your notebook!

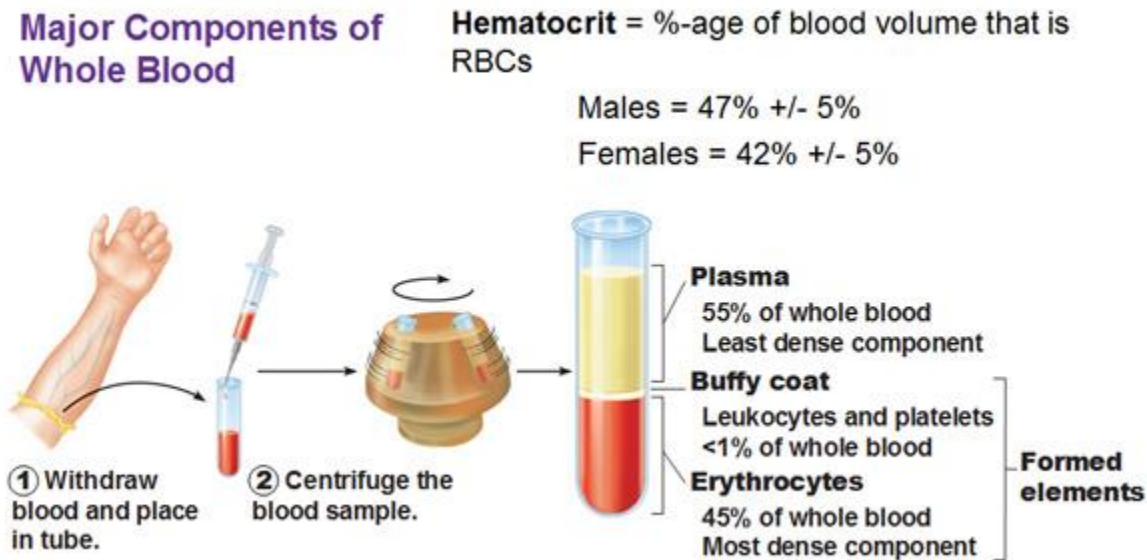


# Normal Human Blood Smear



# Hematocrit

- Hematocrit (he-MAT-uh-krit) is the proportion of total blood volume that is composed of red blood cells.
- Use a centrifuge to spin the blood very quickly in a tube.
- This motion separates blood into three parts: the fluid component (plasma), red blood cells and other blood cells.



# How to calculate Hematocrit level

- Use a ruler to measure (in millimeters) the layers in each tube. Record these measurements in your lab notebook
- Calculate the **percentage of Red Blood Cells (erythrocytes)** in each test tube; divide the measurement for the bottom layer of “blood” by the total height of the “blood” in the tube and multiply by 100. Record your answer.
- Calculate the **percentage of plasma** in each test tube by dividing the measurement for the top layer of “blood” by the total height of the “blood” in the tube and multiply by 100.

# Title: RBC Hematocrit Levels (% of total blood)

Male (low)	Female (Low)	Male (Normal)	Female (Normal)	Male (High)	Female (High)
<42	<35	42-54	35-46	>54	>46

Copy the table into your lab notebooks for reference



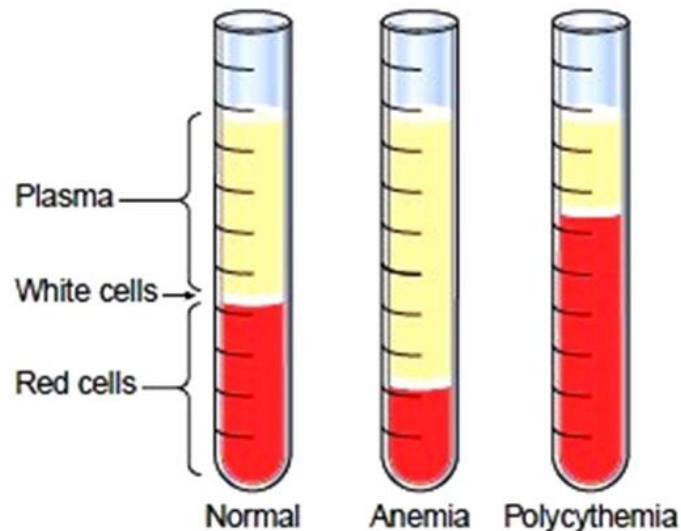
# Hematocrit Levels: Measure of RBC's in Blood

## Higher than normal:

- Dehydration, drug use
- Polycythemia: disorder that causes too many RBC's
- Some parasitic blood diseases

## Lower than normal:

- An insufficient supply of healthy red blood cells (anemia)
- A large number of white blood cells due to long-term illness, infection, leukemia, lymphoma or other disorders of white blood cells
- Vitamin or mineral deficiencies
- Recent or long-term blood loss



# Some Possible Blood Disorders

## 1. RBC Disorders

- Sickle cell anemia
- Hereditary Spherocytosis
- Thalassemia

## 2. Platelet/Protein Disorders

- Blood clotting
- TPP
- DVT
- APS
- Hemophilia
- Von Willebrand's factor

## 4. WBC Disorders

- Leukemoid Regions
- Leukemia

## 5. Blood Diseases/Parasites

- Malaria
- Dengue fever
- Trypanosoma



# Normal PLEP Levels

<b>CBC</b>	<b>Patient Value</b>	<b>Normal Range</b>
<b>WBCs</b>	<b>5.5 K/uL</b>	4.5-11 K/uL
<b>RBCs</b>	<b>4.5 million/uL</b>	3.5-5.5 million/uL
<b>• Hb</b>	<b>15.6 g/dL</b>	13 - 18 g/dL
<b>• HCT</b>	<b>48%</b>	45% to 52%
<b>PLTs</b>	<b>200 K/uL</b>	150-400 K/uL

**WBCs** – the number of White Blood Cells

**RBCs** - the number of Red Blood Cells

**Hb** - the total amount of Hemoglobin (Hb) in the blood

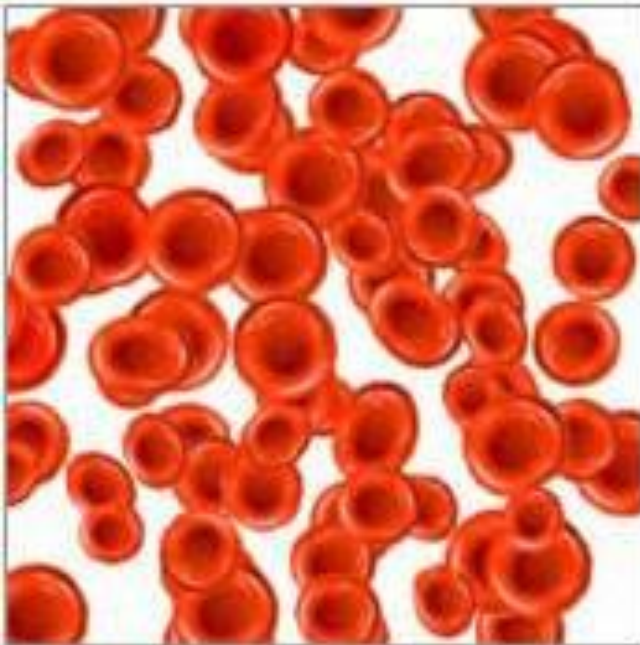
**HCT** - the amount of space RBCs take up in the blood also known as Hematocrit

**PLTs** - number of platelets

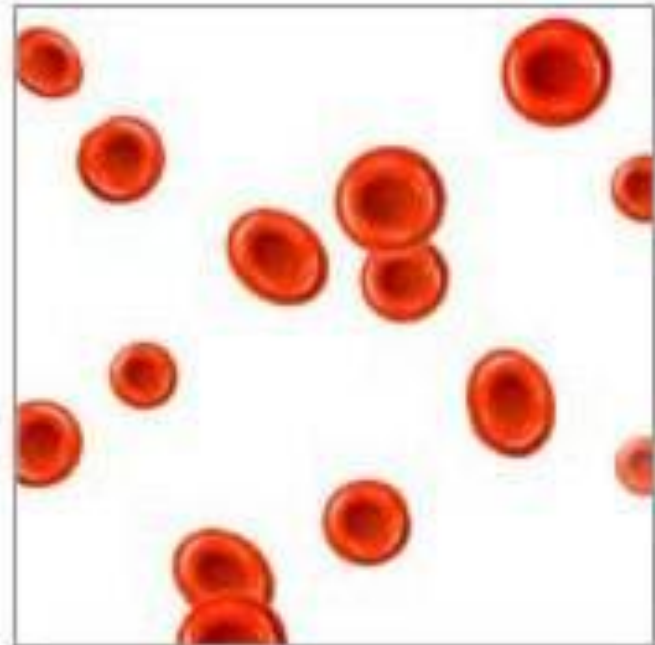
# 1. Red Blood Cell Disorders

- Anemia = lack of Red Blood Cells or lack of iron or hemoglobin in the Red Blood Cells

Normal amount of  
red blood cells

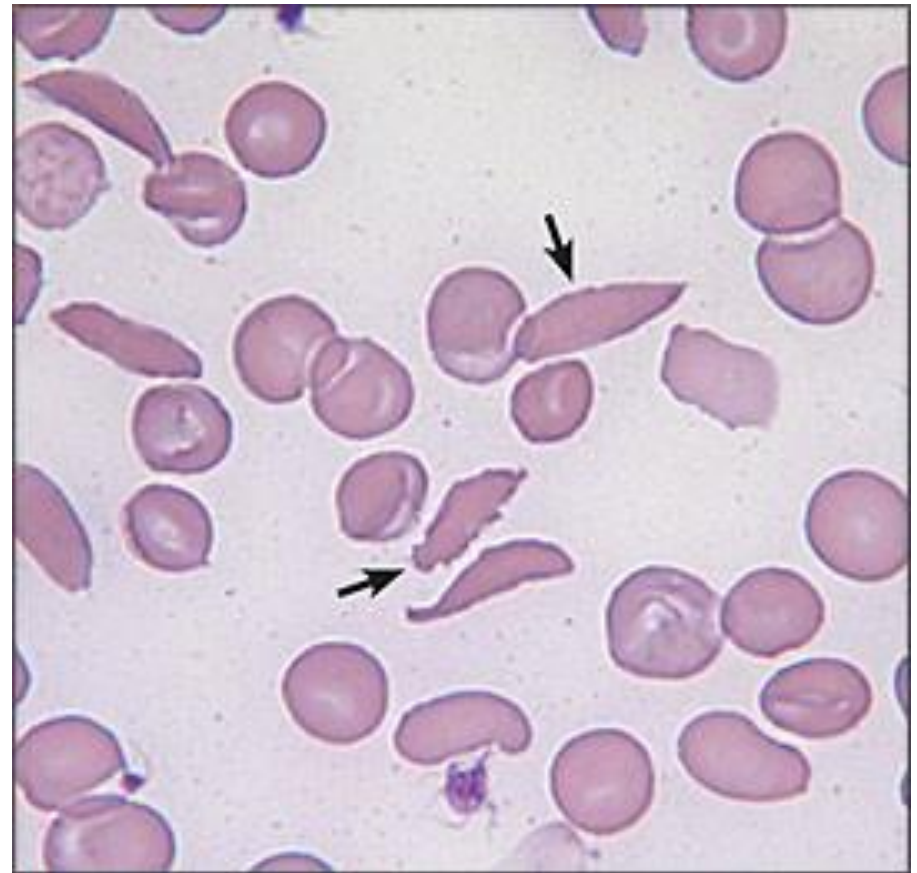


Anemic amount of  
red blood cells



# Sickle Cell Anemia

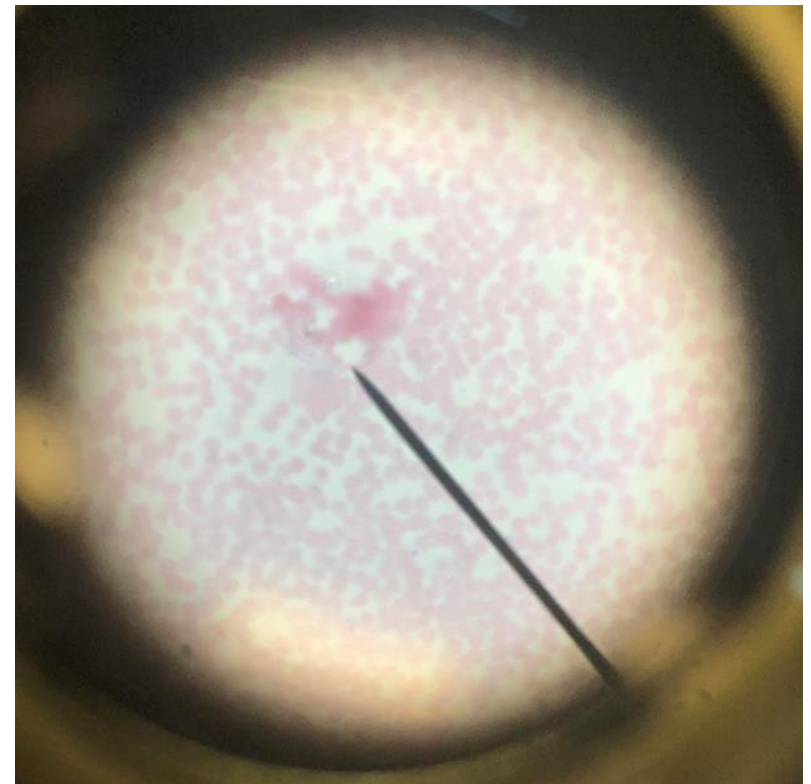
- Genetic blood disorder
- RBC's are misshapen, long and skinny and cannot flow smoothly through the veins
- May cause blood clots, damage to organs, stroke or heart attack



# Sickle Cell images from lab

- Look for differences in shape, color, number
- More white blood cells
- Clots or clumps of cells

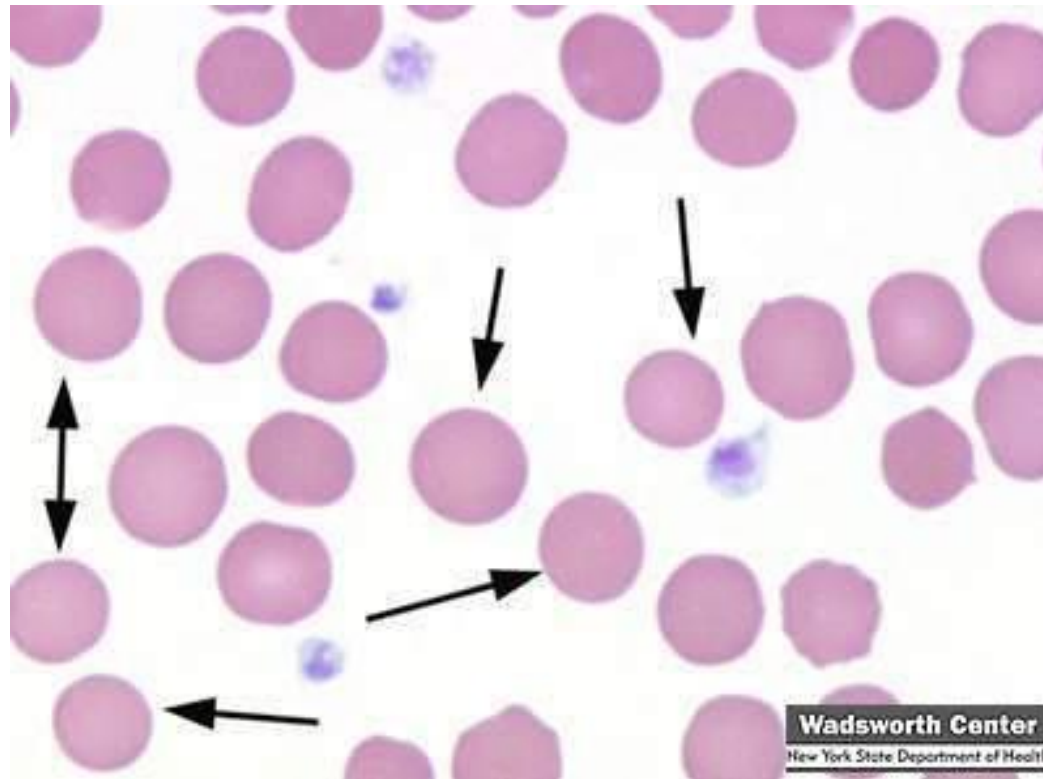
- Maddy and Kaden p.3





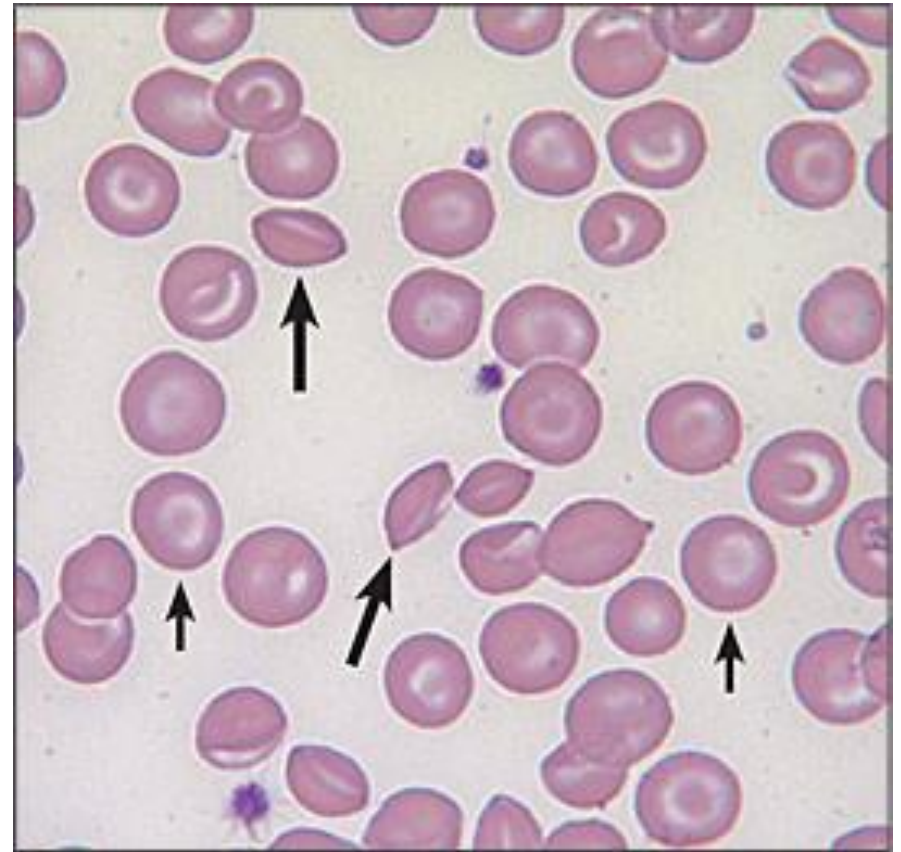
# Hereditary Spherocytosis

- RBC's become enlarged and round due to genetic mistakes
- The spleen does not recognize these cells and destroys them causing anemia, exhaustion and lack of oxygen in cells



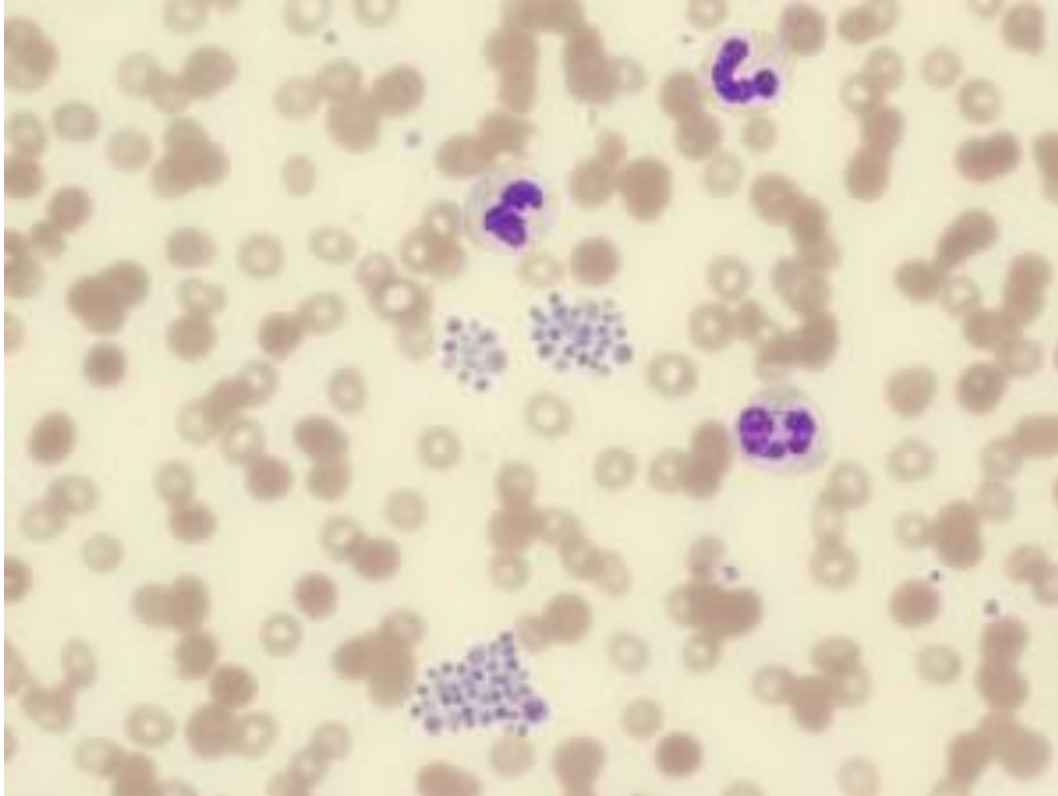
# Thalassemia

- Genetic blood disorder
- Causes a mistake in the protein hemoglobin which carries oxygen in the Red Blood Cells
- Misshapen clam-like RBC's cause anemia and skeletal abnormalities



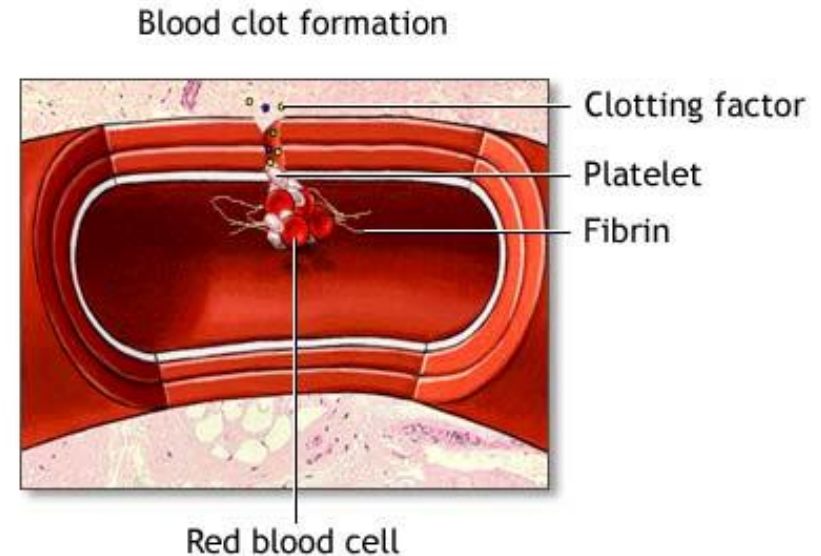


## 2. Platelet Disorders

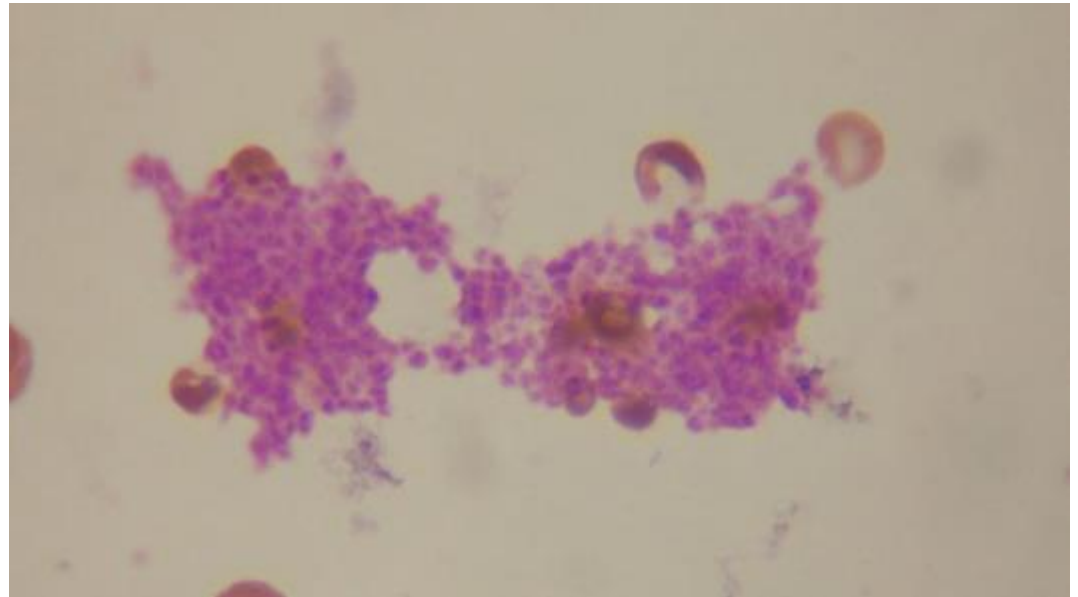


# Blood Clotting

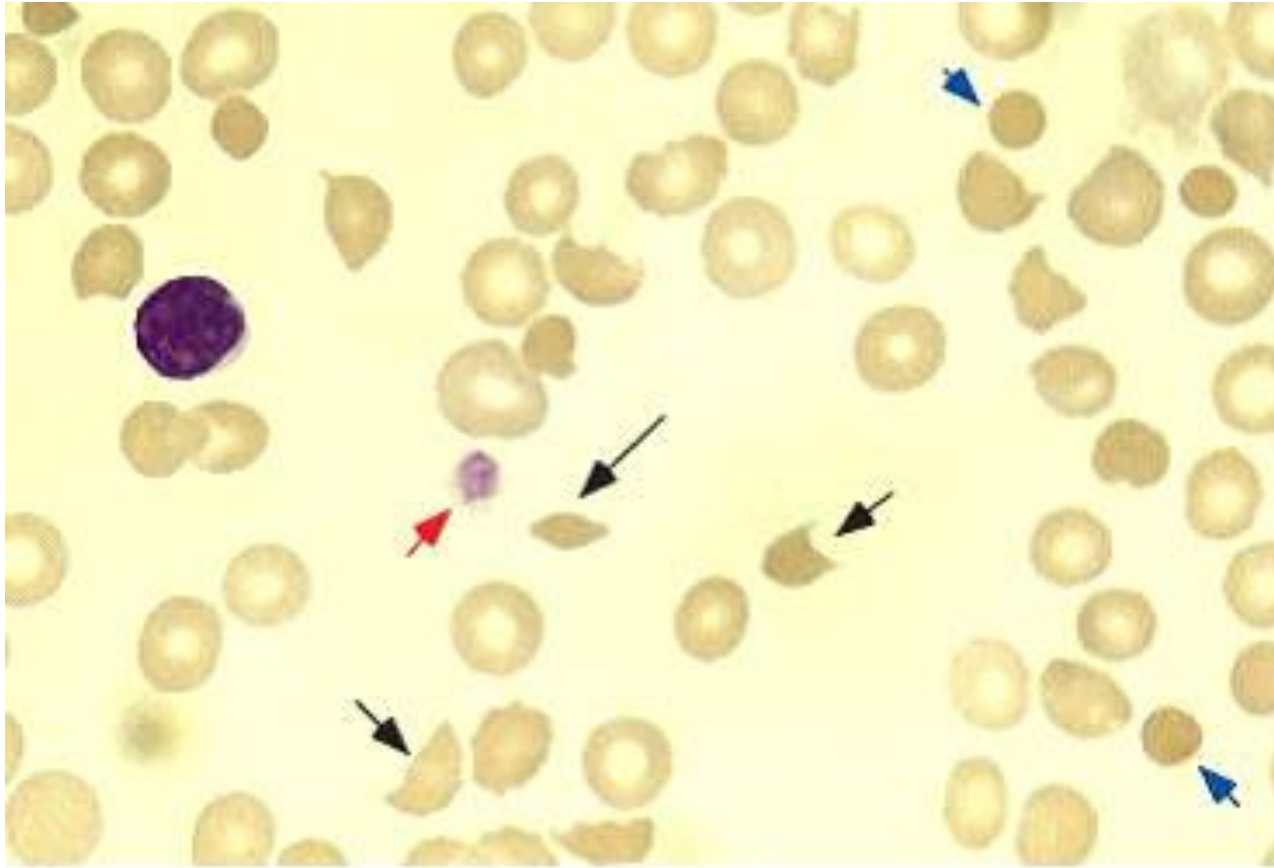
- Occur when platelets group up inside blood vessels
- Can cause stroke or heart attack if they clog a vein or artery with cells and fibrin
- May be genetic or not



ADAM.



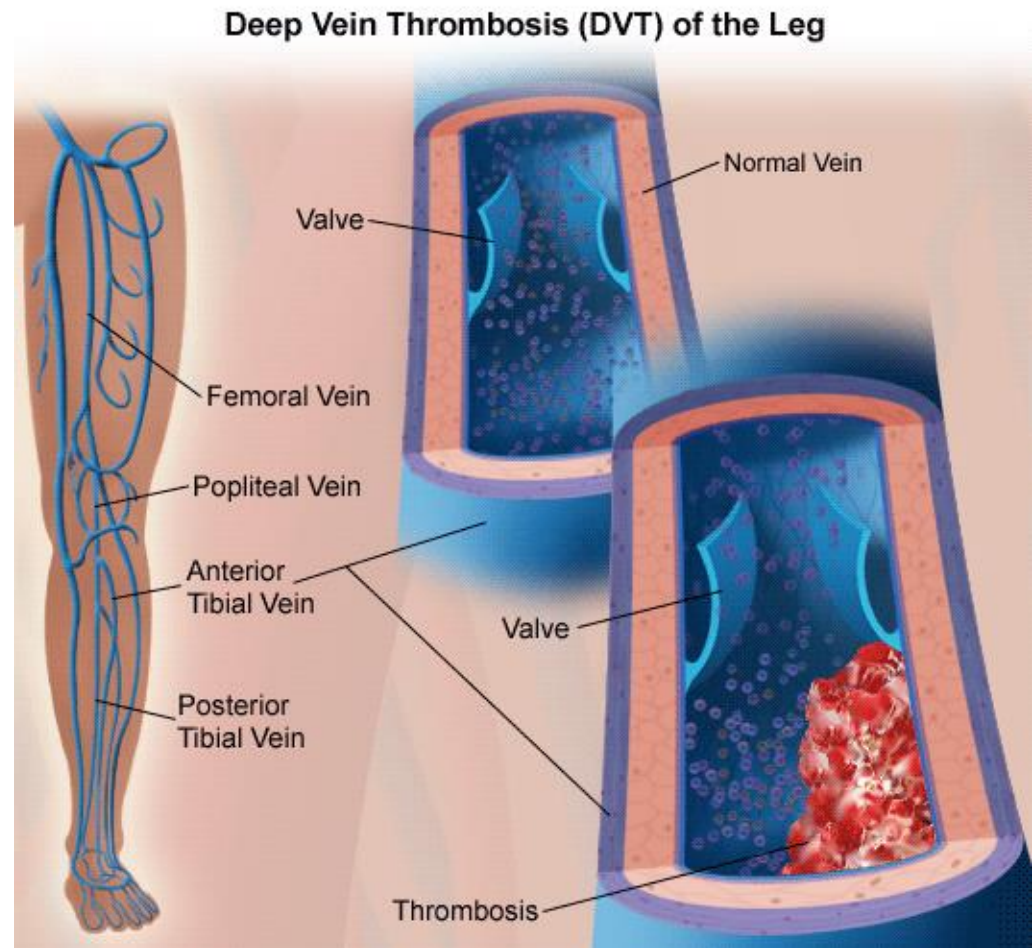
# TTP--Thrombotic thrombocytopenic purpura



The smear shows multiple helmet cells (small black arrows), other fragmented red cells (large black arrow); microspherocytes are also seen (blue arrows). The platelet number is lower than normal with the large platelet clumps (red arrow) suggesting TTP

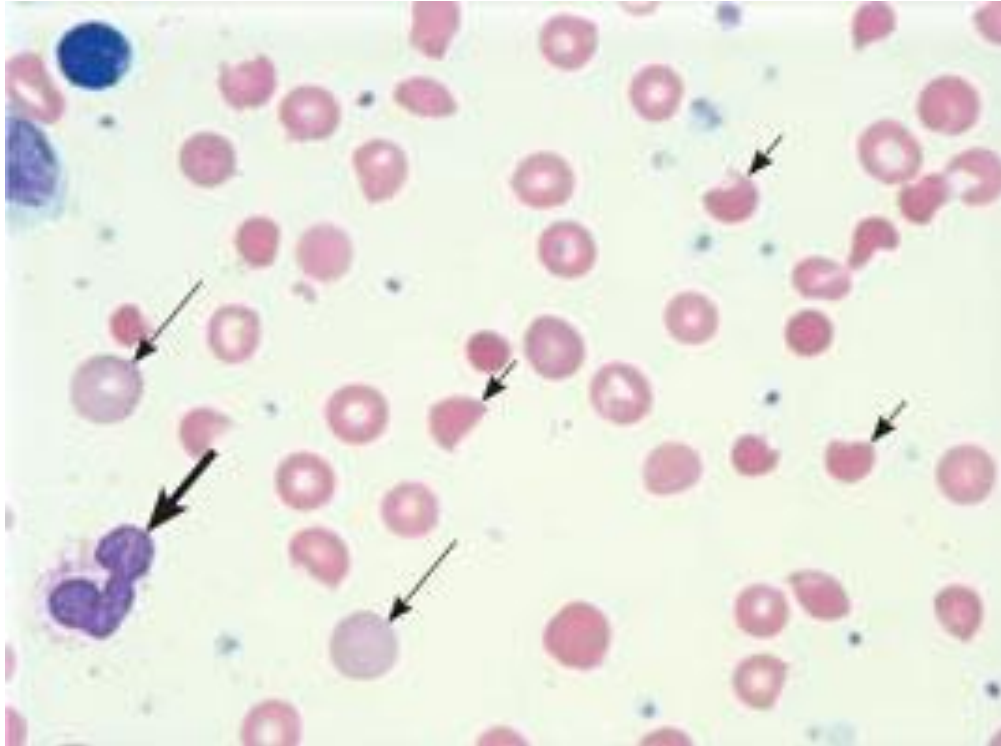
# DVT—Deep Vein Thrombosis

- Clot forms in deep blood vessels, usually in lower leg or thigh
- Can travel to lungs causing pulmonary embolism
- Sometimes occur after sitting for long periods of time, i.e. airline travel





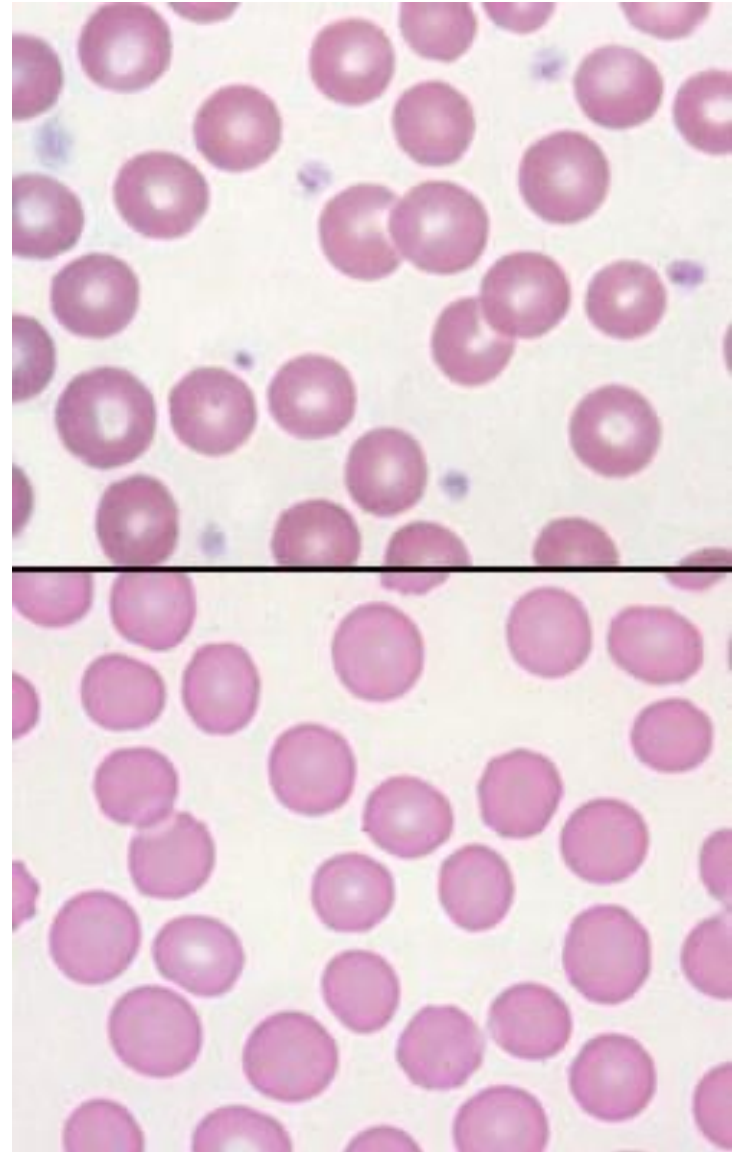
# APS--Antiphospholipid Antibody syndrome



Antiphospholipid syndrome is a disorder in which your immune system mistakenly produces antibodies against certain normal proteins in your blood. Antiphospholipid syndrome can cause blood clots to form within your arteries or veins as well as pregnancy complications or Deep Vein Thrombosis (DVT). RBC's appear damaged.

# Hemophilia and Von Willebrand's Factor

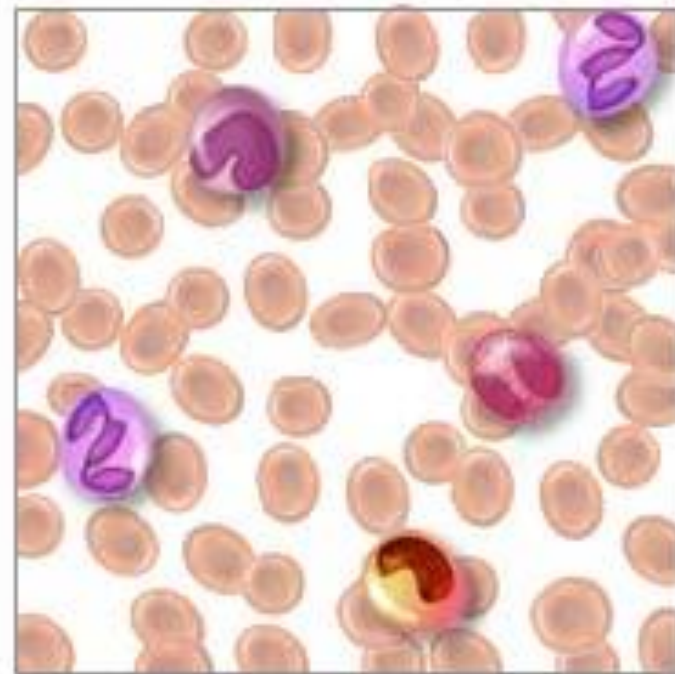
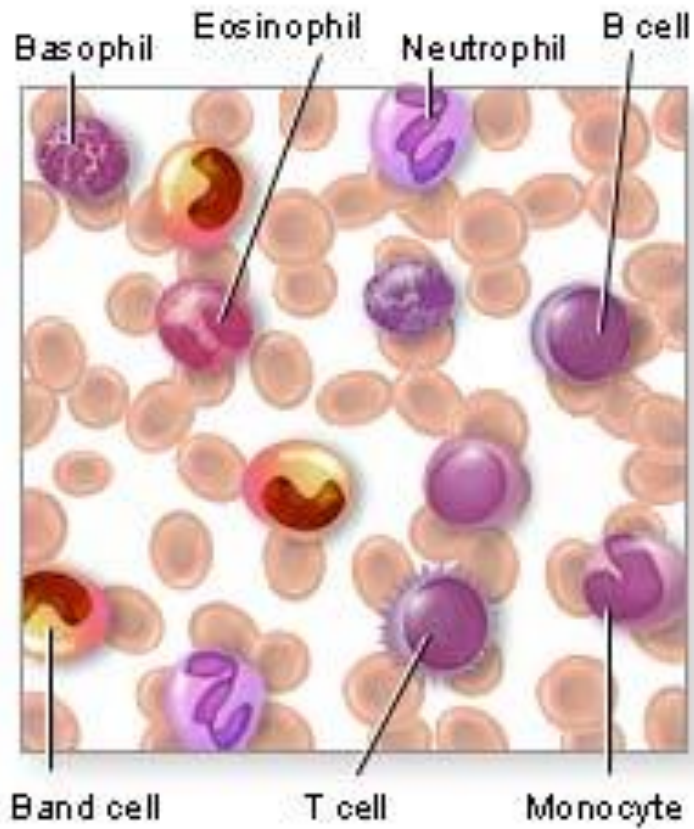
- Genetic disorder caused by lack of platelets and clotting factors in the blood
- Top image is a normal blood smear, bottom is from a patient with hemophilia
- Causes uncontrolled bleeding, external or internal
- Lowered hematocrit levels



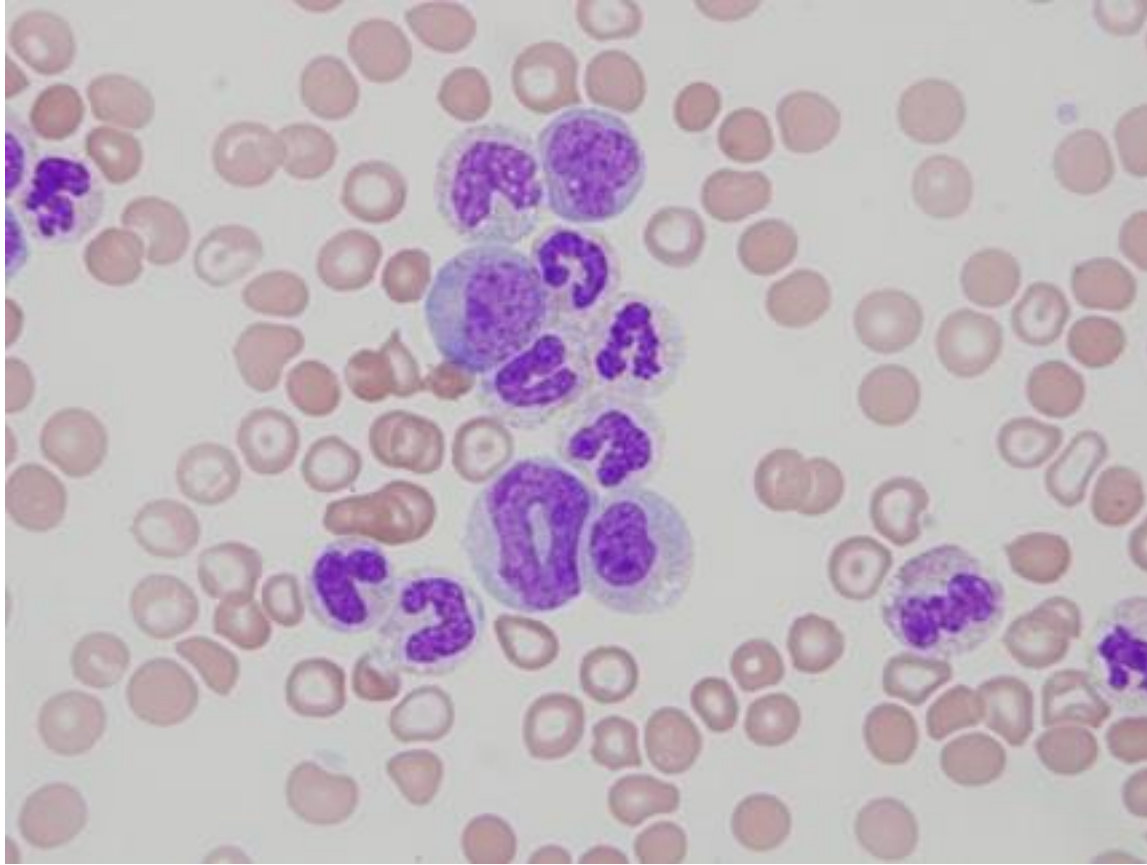
# 3. White Blood Cell Disorders

High WBC count

Low WBC count



# Leukemoid reaction

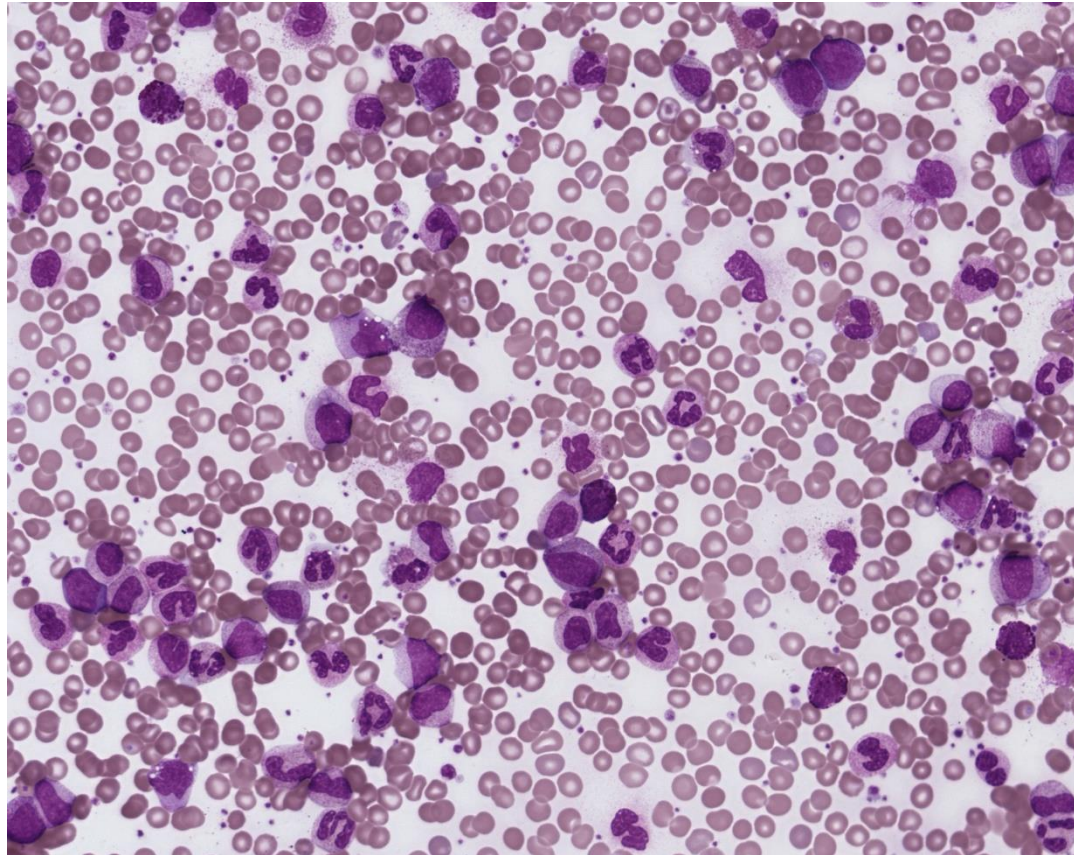


The term **leukemoid reaction** describes an elevated white blood cell count as a response to stress or infection from disease (as opposed to a primary blood malignancy, such as leukemia).



# Leukemia

Leukemia is a type of cancer of the blood or bone marrow characterized by an abnormal increase of immature white blood cells called “blasts.”



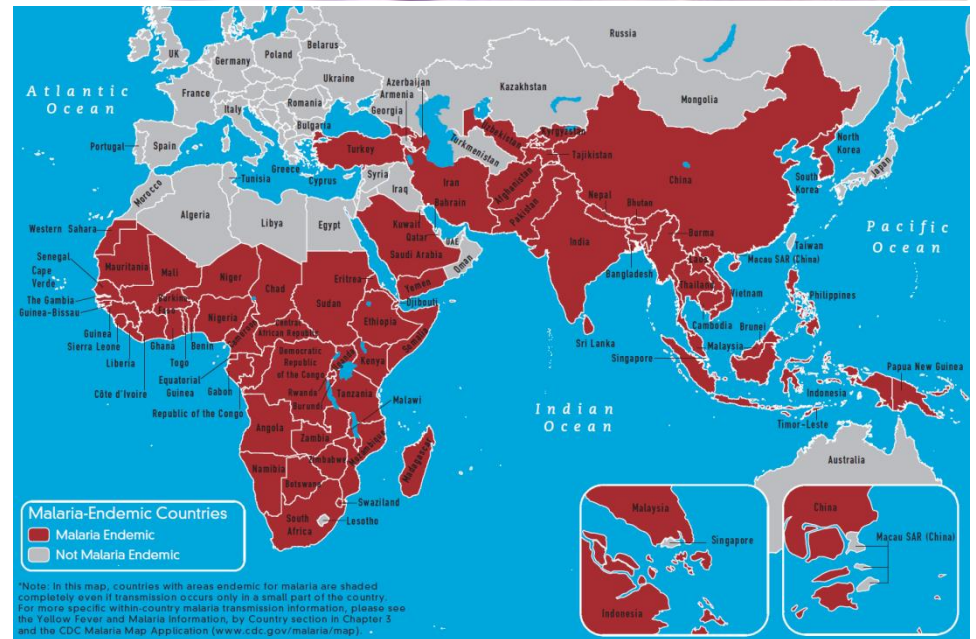
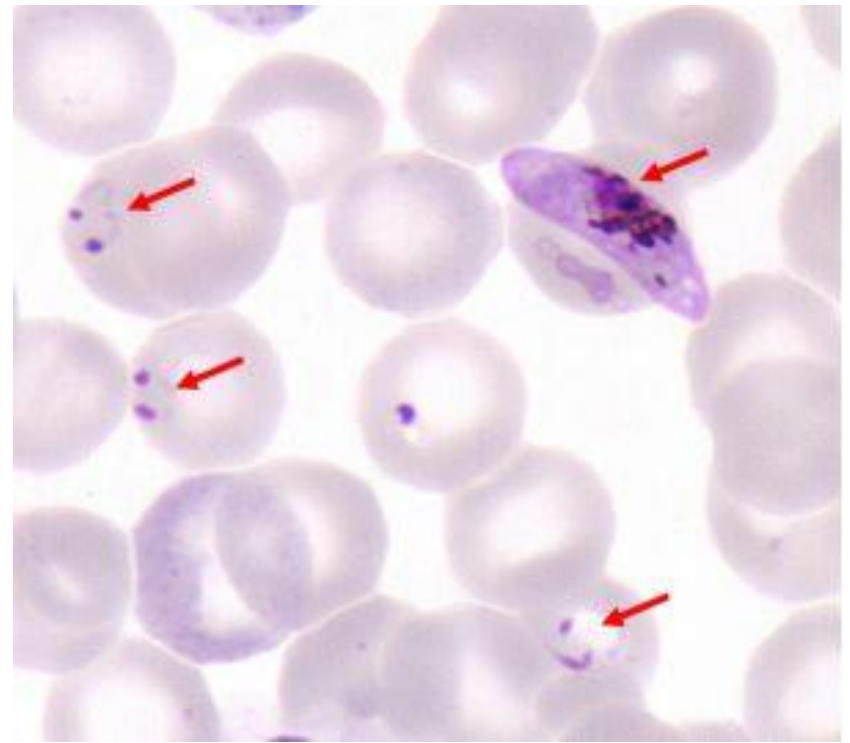
## 4. Blood Diseases/Parasites

- Some parasites can be bloodborne. This means:
  - the parasite can be found in the bloodstream of infected people
  - the parasite might be spread to other people through exposure to an infected person's blood (for example, by blood transfusion or by sharing needles or syringes contaminated with blood).



# Malaria

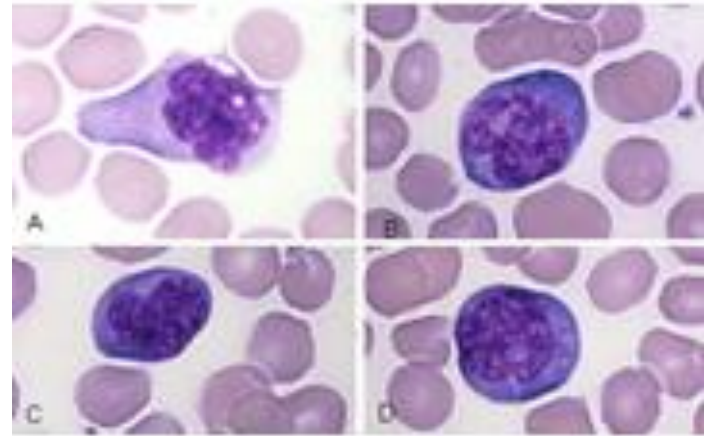
- Blood parasite carried by mosquitoes
- *Plasmodium* protist enters blood cells, destroys them and reproduces in the liver
- Symptoms include fever, headache, coma and death



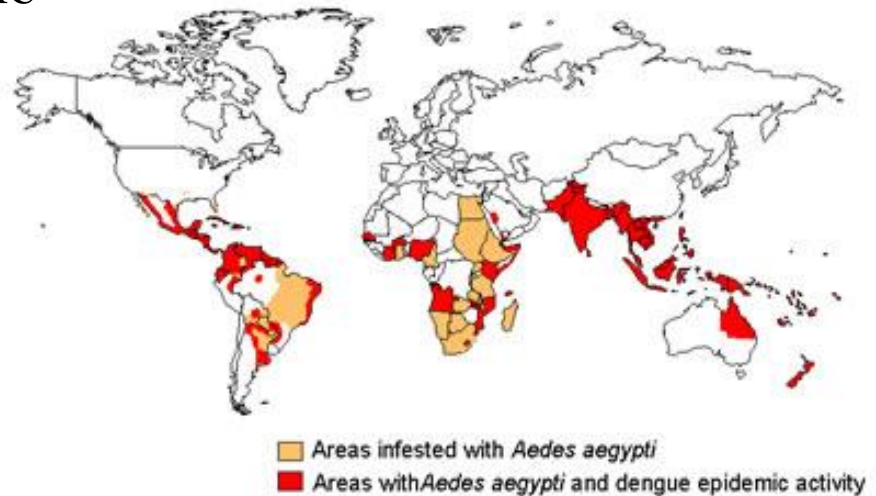


# Dengue Fever

- Virus spread by mosquitoes
- Infects white blood cells causing abnormal lymphocytes
- Fever, chills, extreme bone and muscle pain
- High hematocrit values

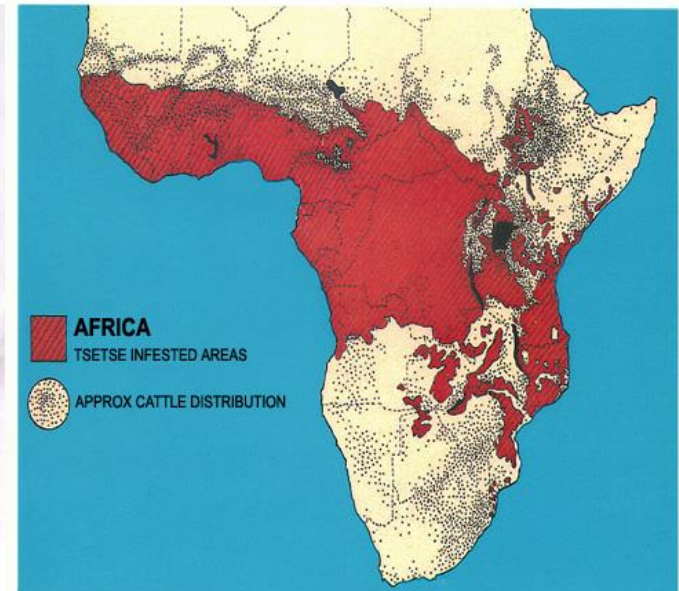
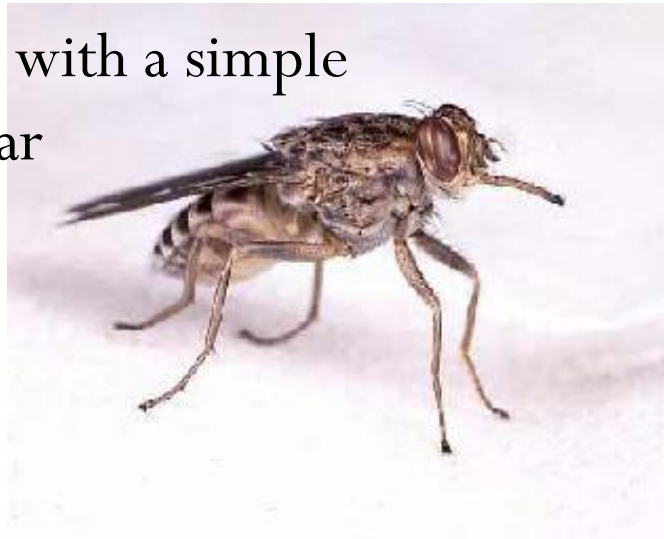
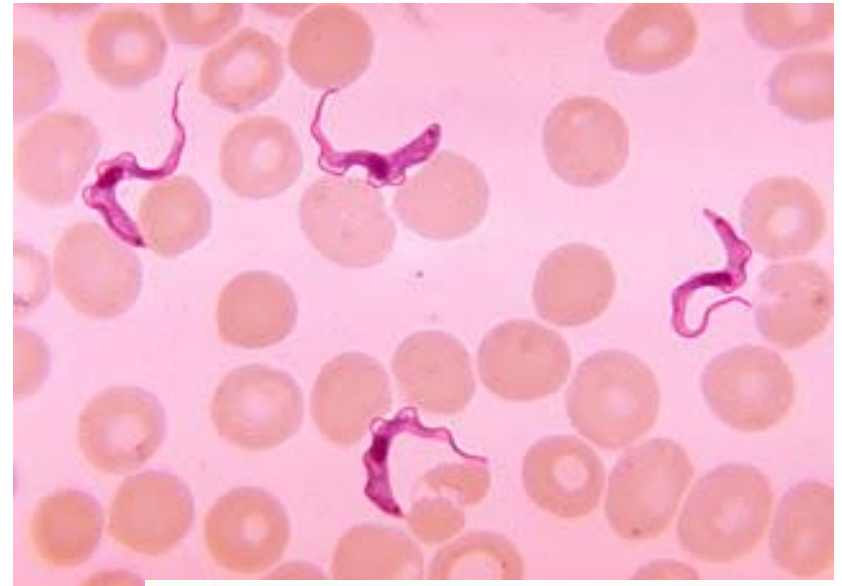


## World Distribution of Dengue - 2005



# Trypanosoma: African Sleeping Sickness

- Parasitic protazoan spread by the bite of the Tsetse fly
- Causes swelling of lymph nodes, kidney disorders, confusion, fatigue and insomnia
- Diagnosed with a simple blood smear



# Helpful Websites

- CDC Blood Parasites:  
<http://www.cdc.gov/parasites/blood.html>
- Mini-Med School: <http://www.seplessons.org/node/2798>
- Medline Plus:  
<http://www.nlm.nih.gov/medlineplus/blooddisorders.html>
- Web MD: <http://www.webmd.com/a-to-z-guides/blood-disorder-types-and-treatment>
- American Society of Hematology:  
<http://www.hematology.org/Patients/Blood-Disorders/5220.aspx>
- Wikipedia: Blood Disorders Category:  
[http://en.wikipedia.org/wiki/Category:Blood\\_disorders](http://en.wikipedia.org/wiki/Category:Blood_disorders)