LAB VALUES PREDICTING YOUR PATIENT'S FUTURE

Kelli Howard, FNP-BC, MSN, RN

OUTCOMES

- Review common laboratory values
- Highlight aspects of care for the patient with laboratory value problems
- Explore laboratory values associated with prescribed medications
- Discuss case problems and studies related to laboratory value issues

NCLEX LABS

CBC (WBC, RBC, H & H)	Platelets	Sodium	Potassium	Chloride
Magnesium	Phosphorous	BUN/ Cr	AST/ALT/ ALP	Protein/Albumin
PT, PTT, INR	Urinalysis	Glucose/ HgbA1C	Cholesterol	HDL/LDL
Ammonia	Bilirubin			

SO WHAT?

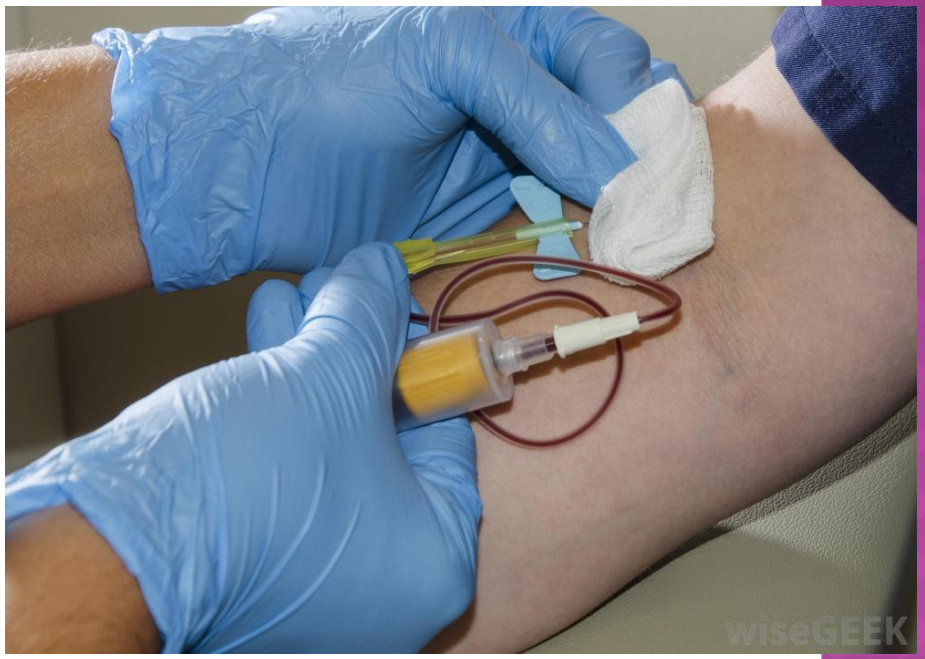
- Not just a memory thing….
- Determine progress or status of a client
- Evaluate hydration of patient
- Immediate nursing action may be required
- Assess/Implement

WHY PERFORM LAB TESTING?

- Screening – for evidence of disease
- Diagnosis- helps detect the presence of a condition
- Monitoring- to correlate serum levels with patients response

COLLECTION TUBES

- Why does the order in which blood tubes are drawn matter?
- If you are not sure which lab goes in which tube look it up.



SPECIMEN REQUIREMENT CHART

Order of Draw

LIGHT BLUE — Sodium Citrate

Anti-Thrombin III
Factor Assays◆
Fibrinogen
Lupus anticoagulant◆
Partial Thromboplastin Time (PTT)
Protein C
Protein S
Prothrombin Time (PT/INR)

SERUM — Clot Activator

CEA
Cold Agglutinins◆
Cryoglobulin
Digoxin
Dilantin (Phenytoin)
Phenobarbital
Primidone
Theophylline
Valproic Acid

ROYAL BLUE — No Additive

Amitriptyline
Clomipramine
Copper
Doxepin
Imipramine

SERUM SEP. — Clot Activator

Acetone
AFP
Albumin
Alkaline Phosphatase
Aminophyline
Amylase
Anti-DNA
Anti-Nuclear Antibody
Ascorbic Acid
ASOT
Beta HCG
Bilirubin (Total & Direct)
BUN
CA-125
Calcium
Chloride
Cholesterol/HDL/LDL
CO_2 (Bicarbonate)
Complement C3 & C4
Cortisol
CPK
CPK Fractionation
CPK-MB
C-Reactive Protein
C-Reactive Protein (High Sensitive)
Creatinine
DHEAS
Electrolytes
Estradiol
Estriol

SERUM SEP. — Clot Activator

Ferritin
Folate (Serum)
Free T3
Free T4
FSH
Gastrin
GGT
Globulin
Hepatitis*
HIV (AIDS)*
H. Phylori*
IgA, IgD, IgE, IgG, IgM
Immunoelectrophoresis
Insulin
Iron/TIBC/%Satuation
LH
LDH
LDH Isoenzymes
Lipoprotein Electrophoresis
Lipoprotein Phenotype
Lithium
Magnesium
Mono Test
MSS/IPS1/IPS2
Phosphorous
Potassium
Prenatal Screen*
Prolactin
Progesterone
Protein Electrophoresis

SERUM SEP. — Clot Activator

PSA & Free PSA
PSA Ratio
Public Health Serology*
RF
Rubella
Salicylates
SGOT (AST)
SGPT (ALT)
Sodium
T3 Total
Tegretol (Carbamazepine)
Testosterone
Total Protein
Transferrin
Triglycerides
TSH
Urea
Uric Acid
VDRL*
Vitamin B12
Vitamin D25 & 1,25◆

GREEN — Sodium Heparin

Chromosome*◆
Collect 2 tubes
LE Cell Prep

LAVENDER — Liquid EDTA

Antibody ID*
Collect 2 tubes
Antibody Screen*
Collect 2 tubes
Blood Grouping*
Blood Film and Differential
Coombs Direct
ESR (Sedimentation Rate)
Eosinophil Count
Folate (RBC)*◆
G-6-P-D*
Hb (A1C)*
Hb Electrophoresis*
Heinz Bodies
Hemoglobin
Hematocrit
HLA-B27*◆
Collect 2 tubes
Homocysteine ◆
Leukocytes
Malaria Smear
MCH/MCHC/MCV
Platelet Count (Thrombocytes)
PTH*◆
RBC
Reticulocytes
Rh Antibodies
Rh Genotype
Sickle Cell Prep
WBC

ROYAL BLUE — K_2 EDTA

Arsenic
Cadmium
Lead
Maprotiline
Mercury
Nickel
Zinc

GREY — Potassium Oxalate & Sodium Fluoride

Ethanol*
Glucose
Glucose Challenge
Tolerance Tests
Glucose
Lactose
Xylose
Lactic Acid

*** REQUIRES DEDICATED TUBE(S).** **◆ PLEASE REFER TO SPECIAL INSTRUCTIONS IN SPECIMEN REQUIREMENT MANUAL.**

ALL SPECIMENS COLLECTED MUST BE CLEARLY LABELLED WITH THE PATIENT'S FIRST AND LAST NAME AND ONE OTHER UNIQUE IDENTIFIER (e.g. D.O.B. OR OHIP NUMBER).
SPECIMENS RECEIVED WITHOUT THE ABOVE PATIENT IDENTIFIERS WILL BE REJECTED.

INSTRUCTIONS:

- Use the above test list to select the correct specimen container(s).
- COLLECT BLOOD IN CORRECT ORDER OF DRAW AS INDICATED ABOVE. If **BLOOD CULTURE** is required, it should be the first collection in the order of draw.
- ALLOW BLOOD TUBES TO FILL COMPLETELY TO ENSURE ACCURATE RESULTS.
- Royal Blue with K2 EDTA, Lavender, Light Blue, Grey and Serum Sep. Tubes should be mixed by gently inverting 6-8 times immediately following collection.
- It is recommended that the Serum Separation Tube be centrifuged.
  (Note: Allow blood to clot at room temperature for 30 minutes in the upright position before centrifuging.)
- If more than 6 tests are requested, a second Serum Separation Tube is required.

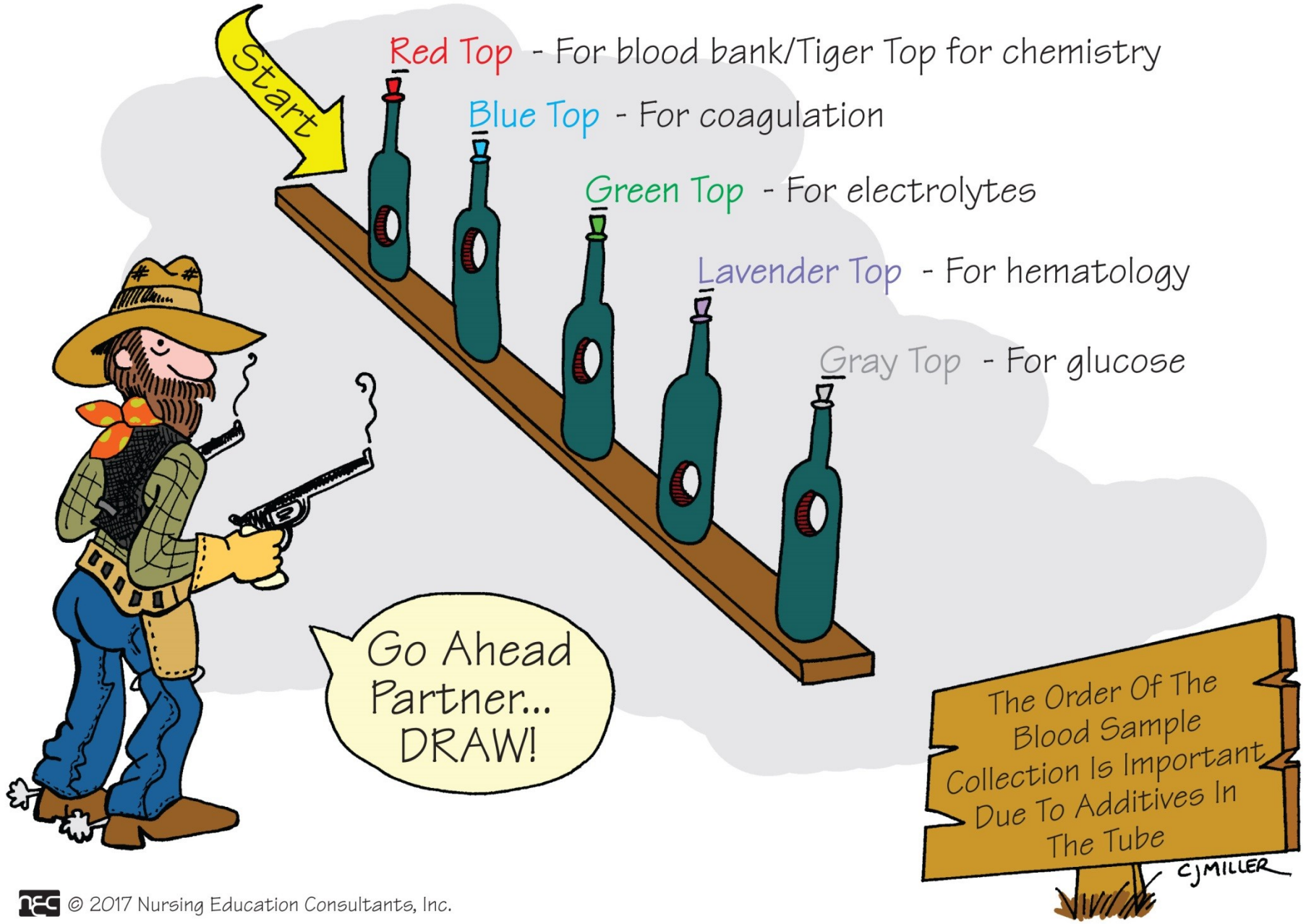
PT/INR & APTT INSTRUCTIONS:

1. PT/INR only — Transport unspun at room temperature within 24 hours.
2. PT/INR and APTT — Transport unspun at room temperature for testing within 4 hours.
   If timing in #2 cannot be met, draw an extra light blue. Centrifuge and separate plasma into an aliquot tube and cap.
   Transport refrigerated.

For sample requirement for unlisted tests, call 416-449-2166.

Alpha Laboratories 1262 Don Mills Road ● Toronto ● ON ● M3B 2W7 ● Phone: 416.449.2166 ● Fax: 416.449.0816

CORRECT ORDER OF THE BLOOD DRAW...



	Order of draw	Stopper color	Additives	Laboratory Use
1	Plain Tube	**Red Top Tube**	no additive	Drug levels, blood bank
2	EDTA Tube	**Lavender Top Tube**	EDTA*	CBC*,HbA1c
3	Heparin Tube	**Green Top Tube**	Sodium Heparin	Plasma chemistry ,ammonia level
4	ESR Tube	**Black Top Tube**	Sodium citrate	Westergren sedimentation rate
5	Glucose Tube	**Grey Top Tube**	Sodium fluoride	glucose tolerance testing, alcohol level
6	PT Tube	**Blue Tube**	Sodium citrate	PT*,PTT*
7	Serum Tube	**Yellow Top Tube**	ACD* SPS*	Whole blood determination
8	Thrombin Tube	**Orange Top Tube**	Thrombin	Chemical testing
9	Gel Yellow tube	**Serum Gel Tube**	contains a clot activator and serum gel separator	various laboratory tests

EDTA=Ethylene diamine tetraacetic acid, ACD= Acid citrate dextrose, CBC=Complete blood count,PT=Prothrombin times, PTT=Partial thrombinplastin times, SPS=sodium polyanethol sulfonate

LEARNING TO ASSESS/IMPLEMENT

- Have I assessed everything?
- Not just about assessing the patient
- What data do I need?

ASSESS

- What am I going to do?
- Must reassess after implementing

IMPLEMENT

THINGS THAT EFFECT LAB VALUES

- Age
- Gender
- Race
- Pregnancy
- Food Ingestion

CBC (COMPLETE BLOOD COUNT)

WBC's

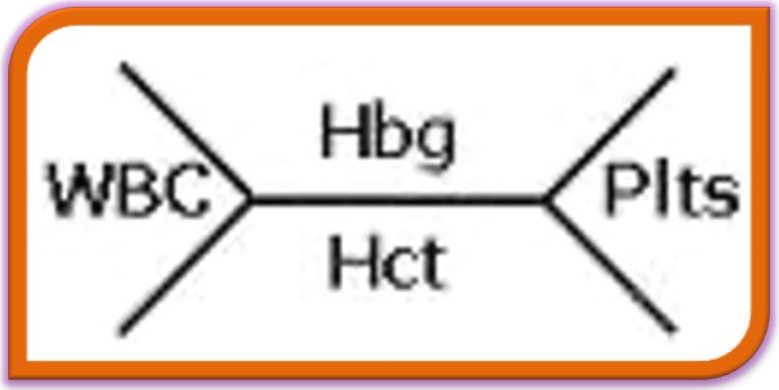
RBC's

Indices

H & H

Plts

Differential



Complete Blood Count (CBC)

- Provides information on cellular components of blood
- Includes RBC count, Hemoglobin (Hgb), Hematocrit (Hct), RBC indices, White blood cell (WBC) count and differential, Platelet count

COMPLETE BLOOD COUNT (CBC)

- RBC- # of red cells per cc/blood
- Hgb- O2 carrying protein
- Hct- Packed volume of RBCs, % of total volume
- MCV-Cell size (normocytic, macro and micro)
- MCH- amount of Hgb per cell
- MCHC- Hgb/Hct per 100ml/RBCs
- RDW- red cell distribution width
- Platelet- # of plt. per cc/blood
- WBC- # of white cells per cc/blood

Common Indications for a CBC

- Infection
- Weakness or Anemia
- Bleeding
- Fluid status

TOTAL WBCS (LEUKOCYTES) 3.6-10.8K/UL

- Measurement of total WBC count
- Part of “routine” testing
- Useful for evaluation of infection, neoplasm, allergy and immunosuppression
- **High**- (leukocytosis): infection, inflammation, tissue necrosis, sepsis Leukemic neoplasia, trauma, stress, dehydration, thyroid storm
- **Low** – (leukopenia): bone marrow failure ie chemo, radiation therapy , overwhelming infections, autoimmune disease

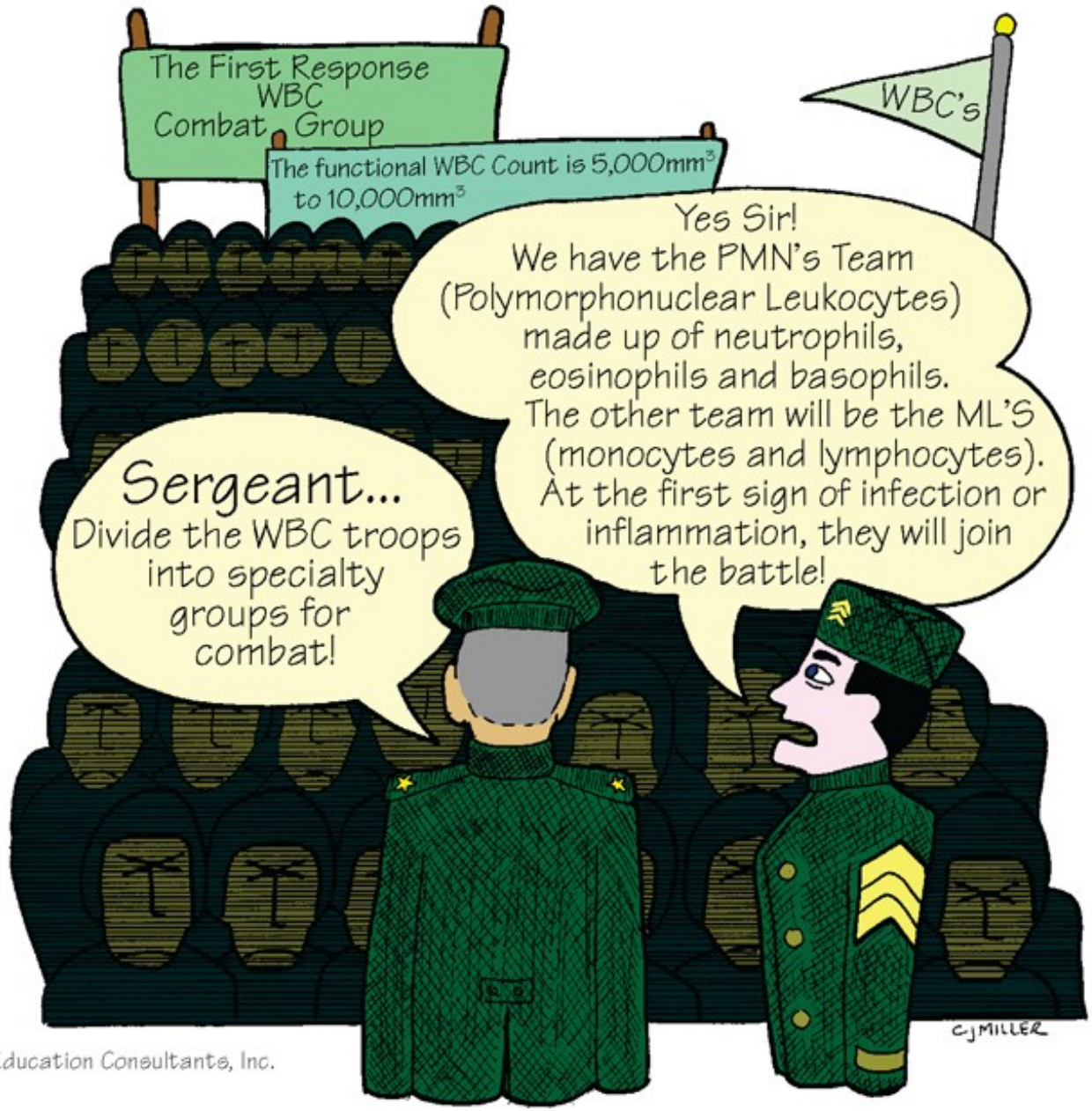
WBC DIFFERENTIAL

- Measurement of percentage of each WBC type in specimen
- Think inflammation or infection
- **Normal:** Neutrophils (50-70 %),
- Lymphocytes (20-40%),
- Monocytes (2-8%),
- Eosinophils (1-4 %),
- Basophils (0.5- 1.0%)

WBC definitions

- Leukocytosis – abnormally large number of leukocytes; generally indicated by WBC count of ≥ 10,000 cells/mm3
- Lymphocytosis – form of actual or relative leukocytosis due to increase in numbers of lymphocytes
- Left shift – increase in the number of immature neutrophils (bands/stabs) found in the blood

WHITE BLOOD CELL (WBC) COUNT



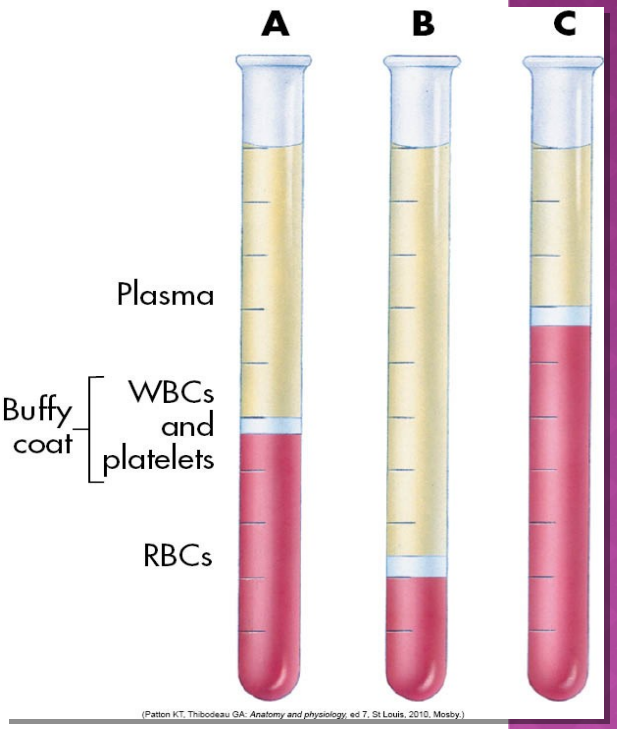
ERYTHROCYTE COUNT (RBC) 3.89-5.40M/UL

- RBC count is closely related to the hemoglobin and hematocrit levels different way of evaluating the number of RBCs in the peripheral blood.
- Count of the number of circulation RBCs in 1mm3 of blood
- **High**: Congenital heart disease , severe chronic obstructive pulmonary disease, polycythemia vera , severe dehydration
- **Low**: Anemia, hemoglobinopathy , cirrhosis, hemolytic anemia, hemorrhage , dietary deficiency, bone marrow failure, prosthetic valves, renal disease, normal pregnancy rheumatoid arthritis, Lymphoma , leukemia , hodgkin disease

RBC (RED BLOOD CELL)

- Carrier of OXYGEN
- Contains hemoglobin molecules

- Indices
  - MCV- 80-95 fL
  - RDW- 11%-14.5%
  - MCH- 27-31 pg
  - MCHC- 32-36 g/dL



= VOLUME

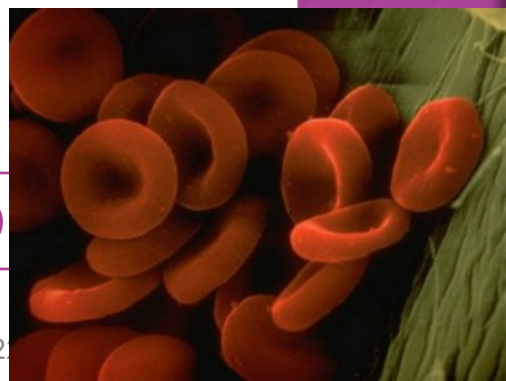
O= OXYGEN

Platelets

- A standing plate in your vessels

Hematocrit

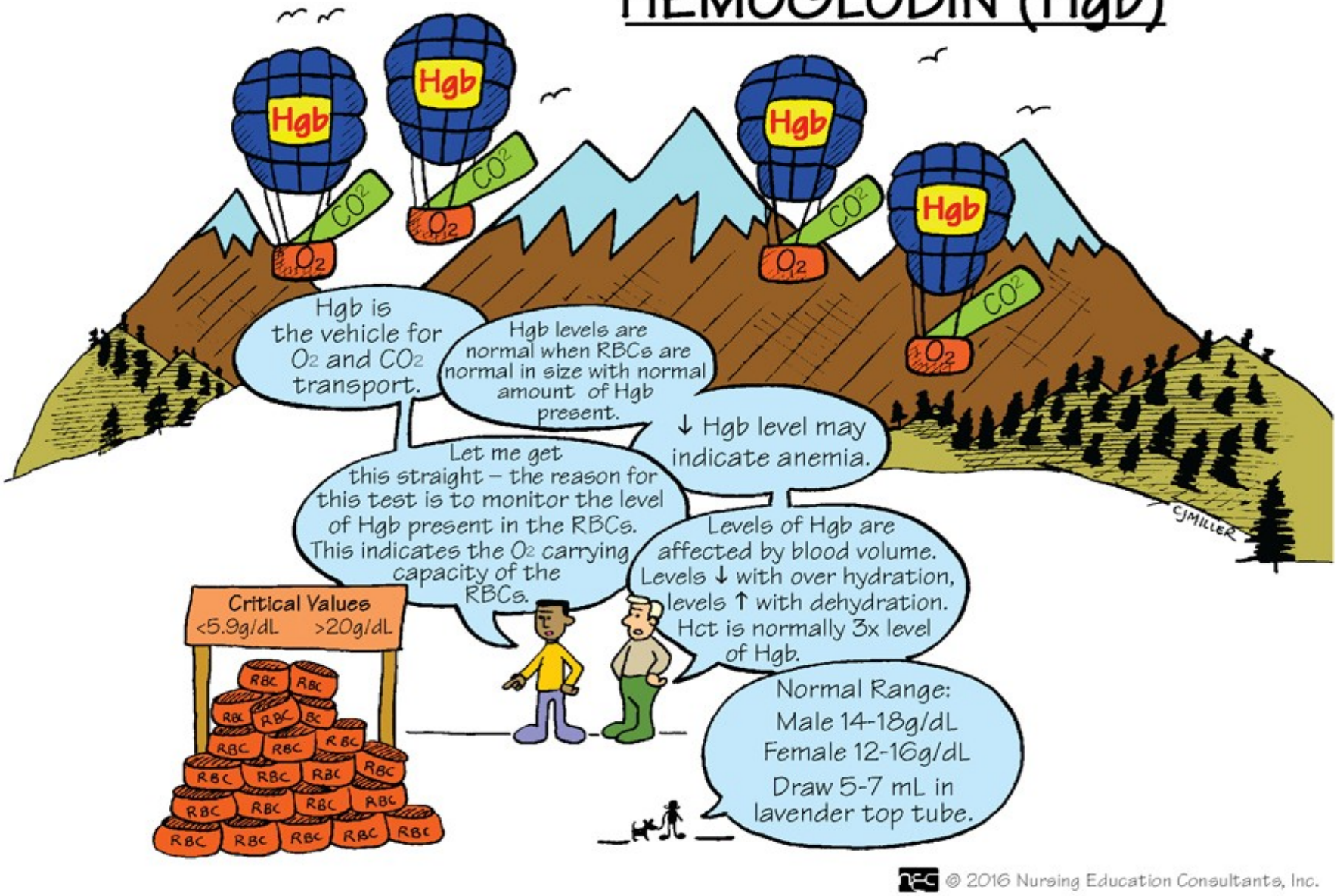
Hemoglob



HEMOGLOBIN (HGB, HB) 12-16 G/DL

- Measures the total amount of Hgb in blood
- **High**: Erythrocytosis, congenital heart disease, severe COPD, Polycythemia Vera, severe dehydration
- **Low**: Anemia, hemoglobinopathy , cirrhosis, hemolytic anemia, hemorrhage , dietary deficiency, bone marrow failure, prosthetic valves, renal disease, normal pregnancy rheumatoid arthritis, Lymphoma , leukemia , Hodgkin disease

HEMOGLOBIN (Hgb)



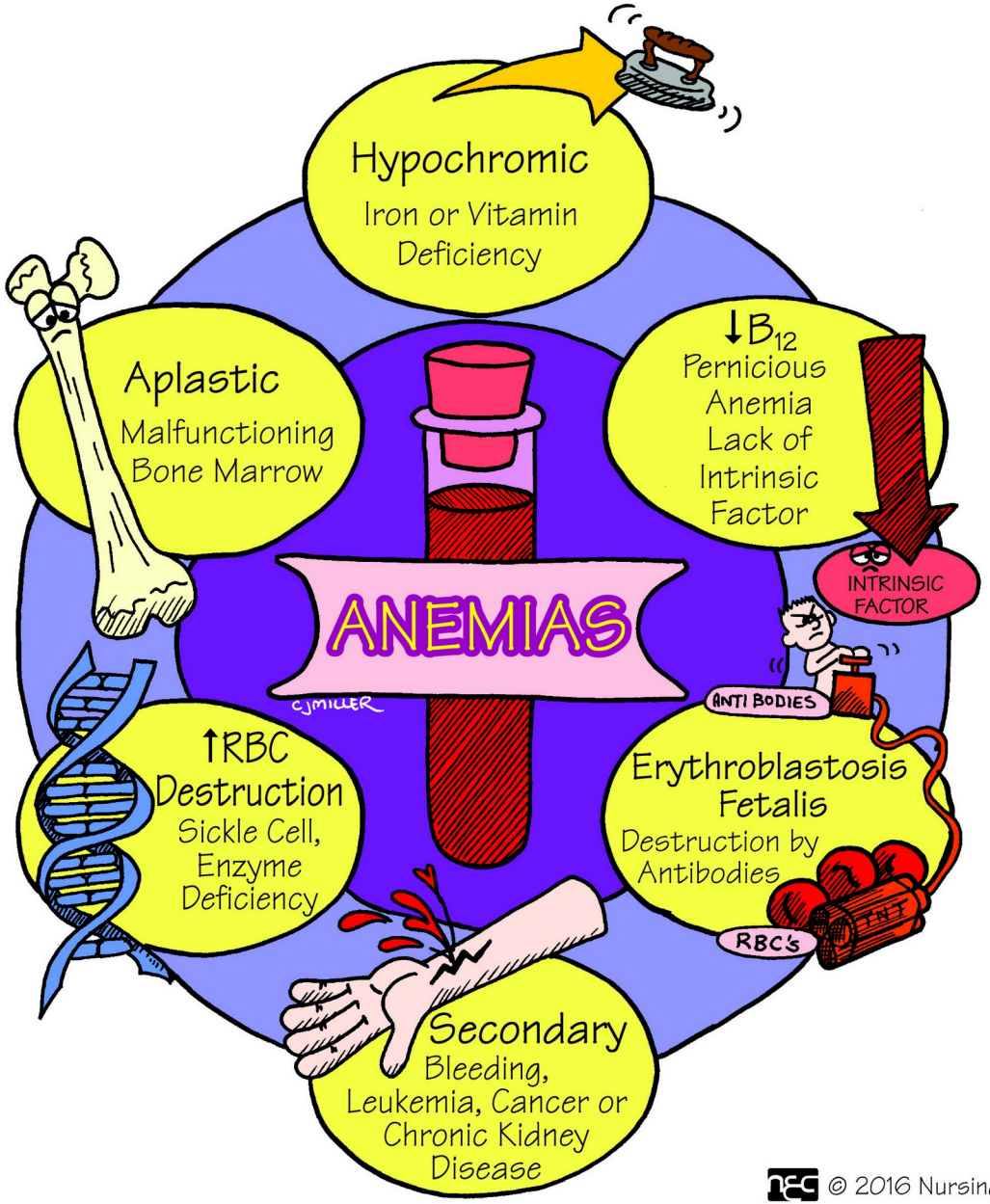
HEMATOCRIT (HCT) 37.0-47.0%

- Hct is an indirect measurement of RBC number and volume
- Part of “routine” testing and anemia evaluation
- Critical- <15% or >60%
- **High**: Erythrocytosis, congenital heart disease, severe COPD, polycythemia vera, severe dehydration
- **Low:** Anemia, hemoglobinopathy , cirrhosis, hemolytic anemia, hemorrhage , dietary deficiency, bone marrow failure, prosthetic valves, renal disease, normal pregnancy rheumatoid arthritis, Lymphoma , leukemia , hodgkin disease

HEMATOCRIT (Hct)

ANEMIA

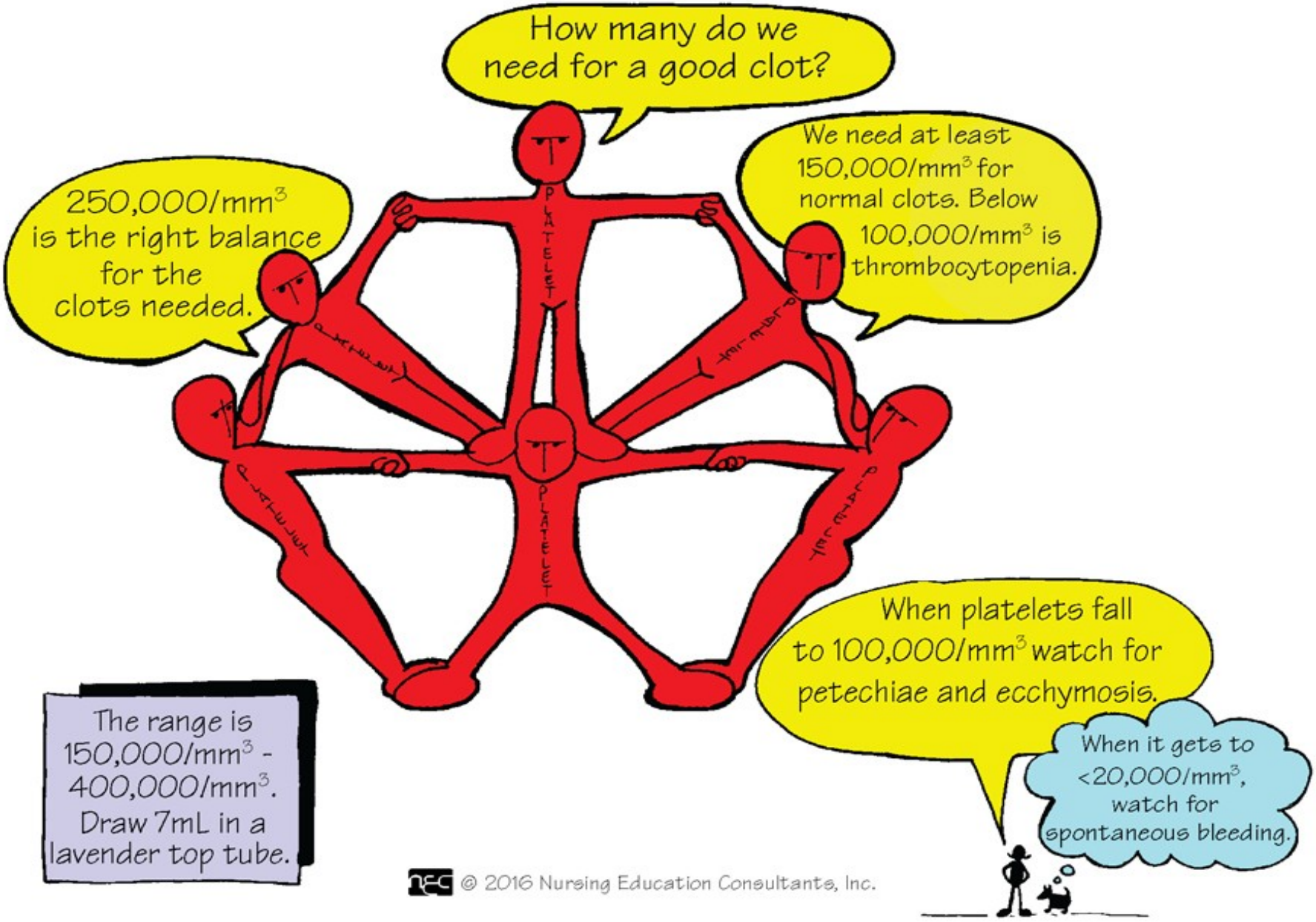
- Decrease in number of RBC’s(erythrocytes)
  - Impaired RBC production
  - Blood loss
  - RBC destruction
  - Combination of all 3
  - Classification
    - Etiology
    - Morphology



PLATELET COUNT (THROMBOCYTE COUNT) 150,000

- Actual count of the number of platelets (thrombocytes) per cubic milliliter of blood
- Formed in the bone marrow
- **High-** (thrombocytosis) malignant disorders , Polycythemia vera, post splenectomy syndrome, Rheumatoid arthritis, Iron deficiency anemia
- **Low** – (thrombocytopenia) Hypersplenism, Hemorrhage, Immune thrombocytopenia, Leukemia, Thrombotic thrombocytopenia, Graves disease, Inherited disorders, DIC, Pernicious anemia, Hemolytic anemia, Cancer chemotherapy , infection

PLATELET COUNT



PLATELET DISORDERS

- Thrombocytopenia:
  - Too few platelets
  - Counts below 50,000= significant bleeding
- Thrombocytosis:
  - Too many platelets
  - Risk of clotting is greatest with counts > 1 million, though > 600,000 can be a problem

Chemistry / Electrolytes

Metabolic Panels

- Basic (BMP)
  - Measure status of
    - Acid/Base balance
    - Blood glucose
    - Electrolyte balance
    - Kidney function
- Complete (CMP)
  - Measure status of
    - BMP Plus:
    - Liver function
    - Blood proteins

Basic Metabolic Panel

- Calcium
- Carbon dioxide content
- Chloride
- Creatinine blood
- Glucose
- Potassium
- Sodium

Complete Metabolic Panel

- Albumin
- Alkaline phosphatase
- Aspartate aminotransferase
- Bilirubin
- Blood urea nitrogen
- Calcium
- Carbon dioxide
- Chloride
- Creatinine
- Glucose
- Potassium
- Total protein
- Sodium

Common Indications for BMP

- Baseline electrolytes
  - Na, K, Cl, HCO3, Mg
  - Many disease processes
- Glucose
  - Diabetes, altered LOC
- Kidney Function
  - BUN, Creatinine

Electrolytes

* **Sodium 136-145 meq/L**
* **Potassium 3.5- 5.0 mmol/L**
* **Chloride 98-106 mmol/L**
* **Calcium 9-10.8 mg/dl**
* **Glucose 70-110 mg/dl**
* **BUN 10-20 mg/dl**
* **Creatinine 0.5-1.1 mg/dl**

Glucose
70-110 mg/dl

- Direct measurement of blood glucose level.
- **High**- (hyperglycemia) Diabetes mellitus, Acute stress response, Cushing syndrome, Chronic Renal failure, Glucagonoma, Acute pancreatitis, Diuretic therapy, Corticosteroid therapy, Acromegaly
- **Low** - (hypoglycemia) Insulinoma, Hypothyroidism, Hypopituitarism, Addison disease, Extensive liver disease, Insulin overdose, Stravation

Glycosylated Hemoglobin Hemoglobin A1c

- Test used to monitor diabetes and or treatment of diabetes. Will tell the physician patient's average blood glucose level over the last three months.

  -Nondiabetic 4%-5.9

  - Good diabetic control <7%

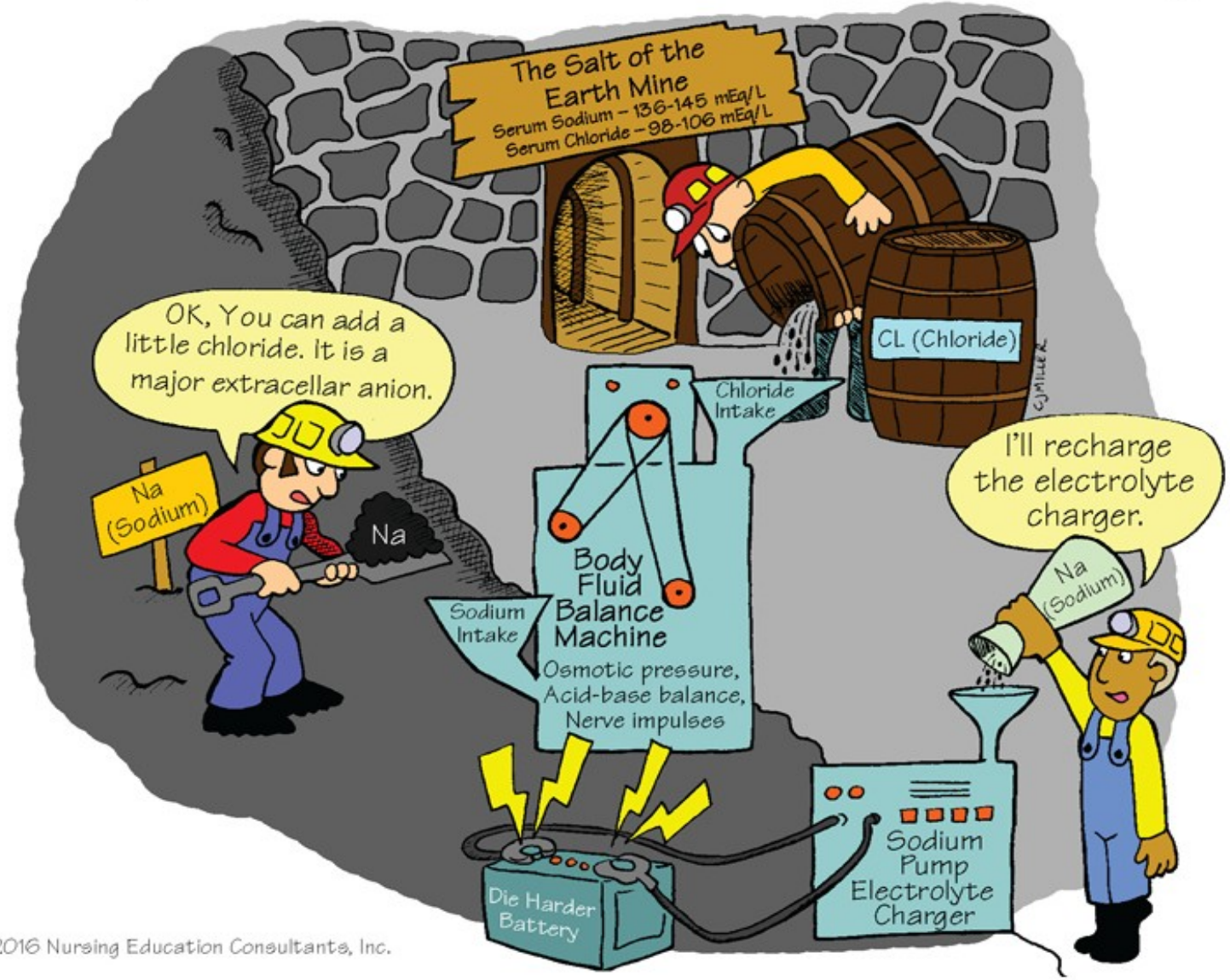
  - fair diabetic control 8%-9%

  - poor diabetic control > 9%

Sodium (Na+)
135-145mEq/L

- Sodium is the major cation in the extracellular space
- Sodium content in the blood is a result of balance between dietary sodium intake and renal excretion
- **High**- (hypernatremia) - increased dietary intake, excessive sodium in IV fluids
- **Low** – (hyponatremia)- deficient dietary intake, deficient sodium in IV fluids, increase free water in body

SODIUM AND CHLORIDE (SERUM)



Potassium (K+)
3.5-5.1 mEq/L

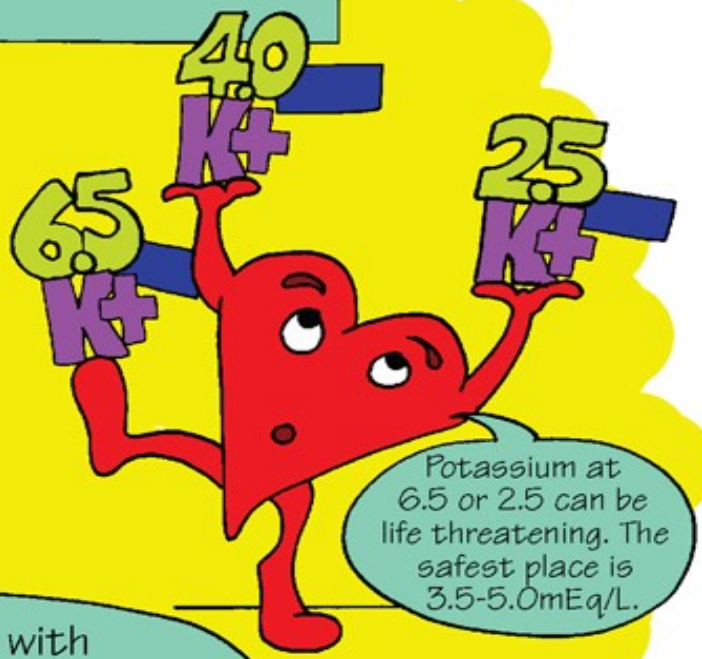
- Important to cardiac function
- Major cation within the cell
- **High-** excessive dietary or IV intake, acute or chronic renal failure, Addison disease, hypoaldosteronism, Aldosterone-inhibiting diuretics, Crush injury to tissues, Hemolysis, Transfusion of Hemolyzed blood, Infection, Acidosis, Dehydration
- **Low**- deficient dietary or IV intake, Burns, GI disorders, Diuretics, Hyperaldosteronism, Cushing syndrome, Renal tubular acidosis, Licorice ingestion, Insulin administration, Glucose administration, Ascites, Renal artery stenosis, Cystic fibrosis, Trauma, Surgery, Burns

POTASSIUM (SERUM)

More Or Less Can Be Life Threatening!

Warning: Watch Potassium Levels in Patients with:

- Renal failure
- Hydration imbalances
- Acid-base imbalances
- Cellular damage
  - burns
  - accidents
  - surgery
- Diabetes



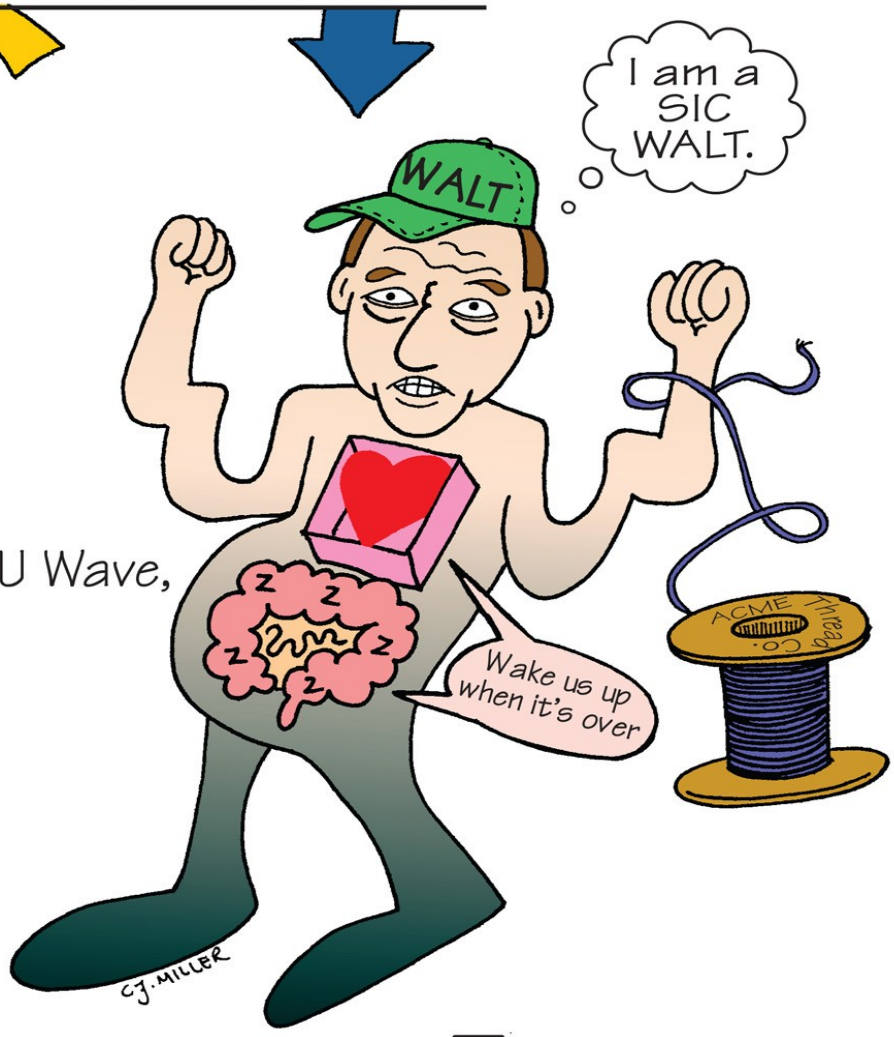
Potassium at 6.5 or 2.5 can be life threatening. The safest place is 3.5-5.0mEq/L.

Watch K^+ levels with Digitalis, Diuretics and IV fluids.

↑K - Irritability, diarrhea, nausea, ECG changes and dysrhythmias.

POTASSIUM DEFICIT

* **A**lkalosis
* **S**hallow Respirations
* **I**rritability
* **C**onfusion, Drowsiness
* **W**eakness, Fatigue
* **A**rrhythmias - Tachycardia
  Flat T Wave,
  Presence of U Wave,
  Heart Block
* **L**ethargy
* **T**hready Pulse
* ↓ Intestinal Motility
  Nausea
  Vomiting
  Ileus



Chloride (Cl-)
98-109 mEq/L

- By itself does not provide much information, but when interpreted with other electrolytes, can give an indication of acid-base balance and hydration status
- Major extracellular anion
- Transport is passive and usually follows sodium
- **High**- (hyperchloremia)-Dehydration, Excessive infusion of normal saline solution, metabolic acidosis, Renal tubular acidosis, Cushing syndrome, Kidney dysfunction, Hyperparathyroidism, Eclampsia, Respiratory alkalosis
- **Low**- (hypochloremia)- Over hydration, Syndrome of inappropriate secretion of antidiuretic hormone, CHF, Vomiting, Chronic respiratory acidosis, Salt- losing nephritis, Addison disease, Diuretic therapy, Hypokalemia, Aldosteronism, Burns

HCO3- (Bicarbonate)
20-30 mEq/L

- Major role in acid-base balance
- Regulated by kidneys
- Used to evaluate pt pH status and electrolytes
- Critical: < 6 mEq/L
- **High-** Severe vomiting, High- volume gastric suction, Aldosteronism, Mercurial diuretic, COPD, Metabolic alkalosis
- **Low**- Chronic diarrhea, Chronic loop diuretic use, renal failure, Diabetic ketoacidosis, starvation, metabolic Acidosis, shock

Calcium
7.6-10.4 mg/dl

- Used to evaluate parathyroid function and calcium metabolism
- Used to monitor patients with renal failure, renal transplantation, hyperparathyroidism, and various malignancies, monitor calcium levels during and after large-volume blood transfusions
- **High**- (hypercalcemia)- Hyperparathyroidism, metastatic tumor to the bone, paget disease of bone, Prolonged immobilization, Mil-alkali syndrome, vitamin D intoxication, Lymphoma, Addison disease, acromegaly, Hyperthyroidism

- **Low**- (hypocalcemia)- Hypoparathyroidism, renal failure, rickets, vitamin D deficiency, osteomalacia, hypoalbuminemia, malabsorption, pancreatitis, fat embolism, alkalosis

Phosphorus
3.0-4.5 M/dl

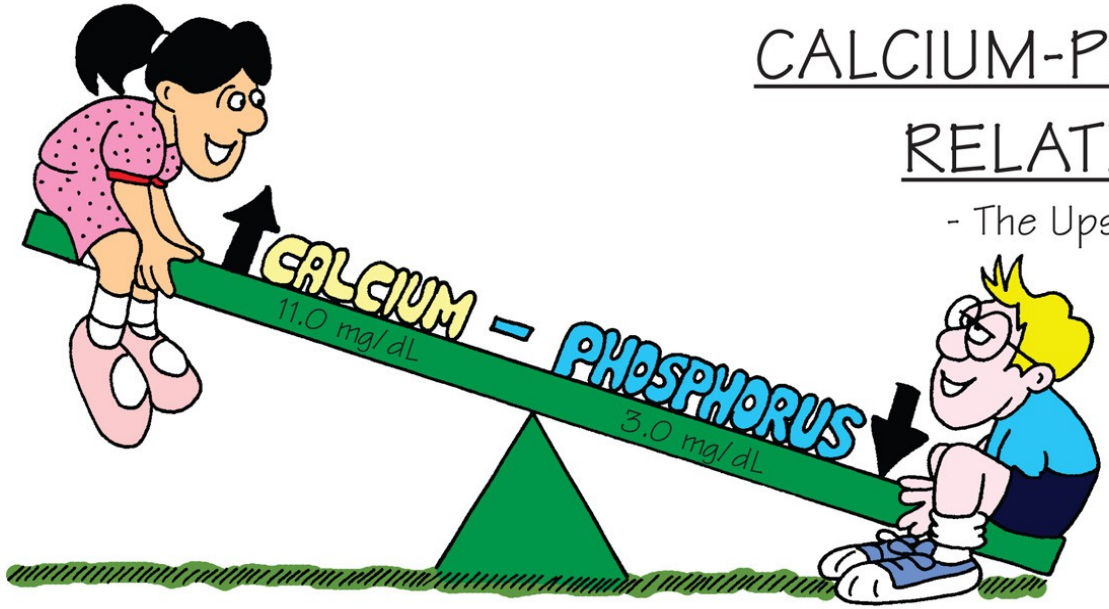
- Test is performed to assist in the interpretation of studies investigating parathyroid and calcium abnormalities

- **High-** (hyperphosphatemia)- hypoparathyroidism, Renal failure, Increased dietary intake, Acromegaly, Bone metastasis, Acidosis, Rhabdomyolysis, Advanced Lymphoma, Hemolytic anemia

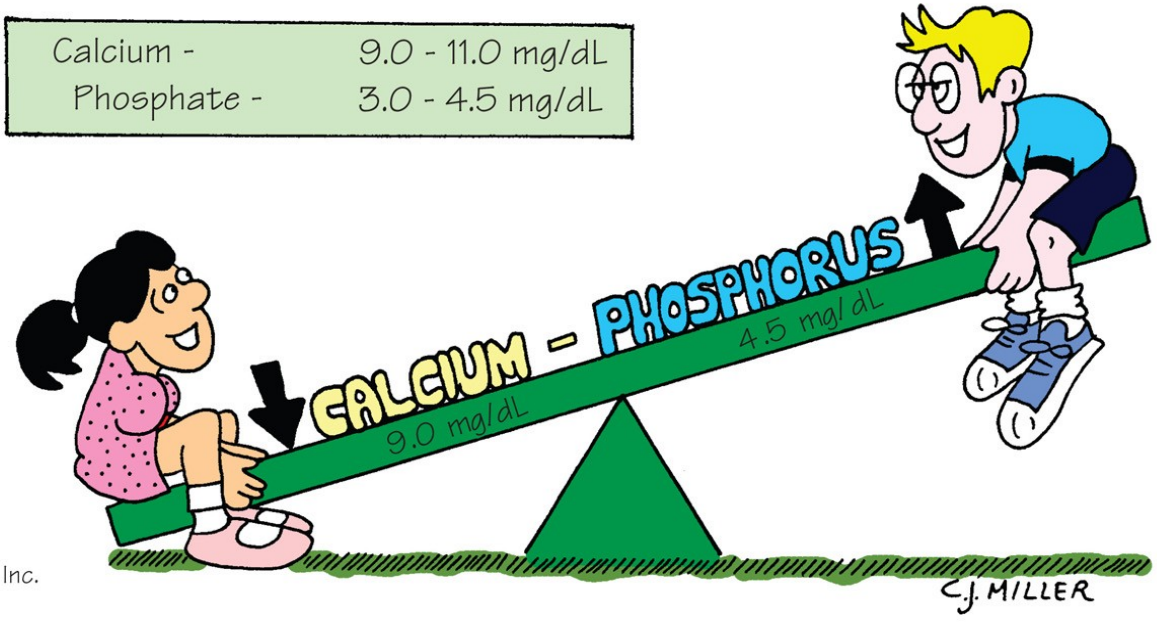
- **Low**-(hypophosphatemia)- Inadequate dietary intake, Hyperparathyroidism, Hypercalcemia, chronic alcoholism, vitamin D deficiency, treatment of hyperglycemia, hyperinsulinism, malnutrition, Alkalosis, gram neg- sepsis

CALCIUM-PHOSPHORUS RELATIONSHIP

- The Ups and Down -



Calcium -	9.0 - 11.0 mg/dL
Phosphate -	3.0 - 4.5 mg/dL



Magnesium
1.3-2.1mEq/L

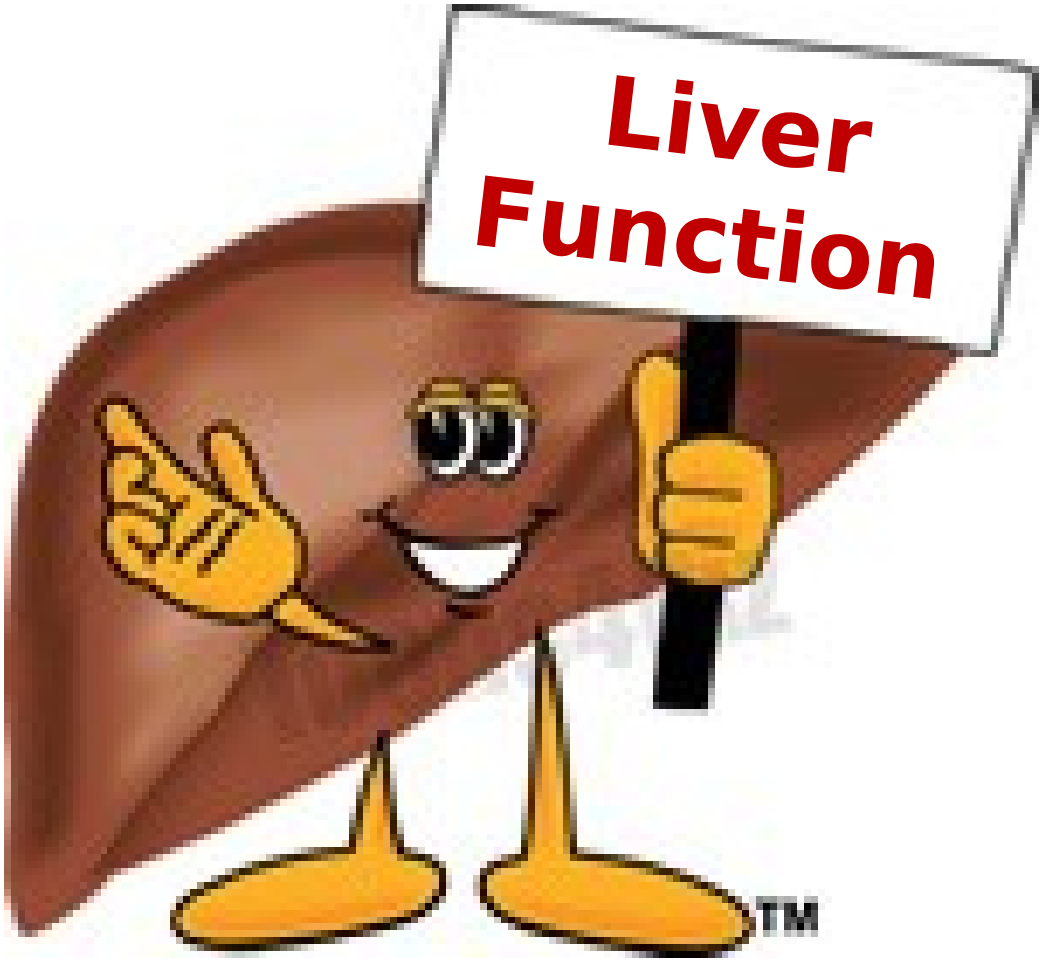
- Found in the body intracellularly about half is in the bone
- Important in calcium metabolism closely tied to calcium levels
- monitor EKG

- **High**- Renal insufficiency, Addison, Ingestion of magnesium containing antacids or salts, hypothyroidism

- **Low** – Malnutrition, Malabsorption, hypoparathyroidism, alcoholism, chronic renal tubular disease, diabetic acidosis

Total Protein
6.4-8.3 g/dl

- Combination of pre-albumin, albumin and globulins
- Used to diagnose, evaluate and monitor the disease course in patients with cancer, intestinal /renal protein-wasting states, immune disorders, liver dysfunction, impaired nutrition, and chromic edematous states


Liver
Function

Hepatic Function Test

- Albumin 3.5-5.0 mg/dL
- AST 0-35 U/L
- Alk Phos 30-120 U/L
- ALT 4 -36 U/L
- Bili total 0.3-1.0 mg/dL
- Direct Bili 0.1-0.3mg/dL
- Ammonia 10-80 mcg/dL

*Most are found in a CMP

Hepatic Components

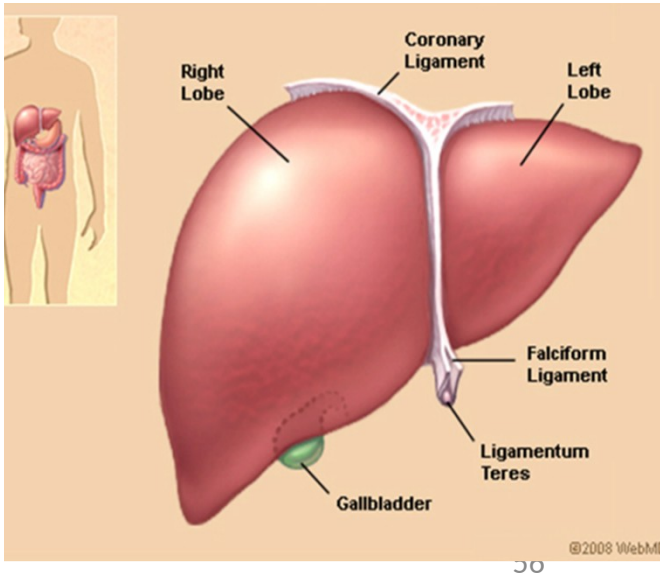
- Albumin- regulates oncotic pressures
- AST- present in tissue with high metabolic activity
- Alkaline Phosphatase- originates in bone, liver, placenta
- ALT/SGPT- occurs in high concentrations in liver
- Bilirubin- byproduct of hemoglobin breakdown, usually present in small amount
- Ammonia- end product of protein metabolism, can affect acid-base balance

Albumin
3.5-5 g/dl

- Formed within the liver and comprises 60% of total protein in blood
- Maintains colloidal osmotic pressure and transports blood constituents-(drugs, hormones and enzymes
- Measures of both hepatic function and nutritional state
- Is synthesized within the liver and is therefore a measure of hepatic function
- **High-** dehydration
- **Low** – malnutrition, pregnancy, liver disease, protein- losing enteropathies, protein-losing nephropathies, Third-space losses, over hydration, increased capillary permeability, inflammatory disease, familial idiopathic dysproteinemia

Albumin

- Protein formed in the liver
- Transports blood, hormones, enzymes



LFT's

- AST- Kidney or Liver
- ALT- Liver only
- ALP- Liver problems, placenta presence, bone problems
- Bilirubin- Break down of RBC's
- Protein/Albumin- producing protein or not? Diet?

Alkaline Phosphatase (ALP)
30-120 u/L

- Used to detect and monitor diseases of the liver and bone

- **High**- primary cirrhosis, intrahepatic/extrahepatic biliary obstruction, primary or metastatic liver tumor, metastatic tumor to the bone, healing fracture, osteomalacia, paget disease, Rheumatoid arthritis, rickets, intestinal ischemia or infarction, myocardial infarction, Sarcoidosis
- **Low-** hypophosphatemia, hypophosphatasia, malnutrition, milk-alkali syndrome, pernicious anemia, scurvy (vitamin C deficiency)

Alanine Aminotransferase (ALT) 4-36 u/L

- Predominantly found in the liver
- Injury or disease affecting the liver parenchyma – causes a release into the bloodstream
- Used to identify and monitor hepatocellular disease of the liver
- **Very high-** Hepatitis, Hepatic Necrosis, Hepatic Ischemia
- **Moderately high-** Cirrhosis, Cholestasis, Hepatic tumor, Hepatotoxic drugs, Obstructive jaundice, Severe burns, Trauma to striated muscle
- **Mildly high-** Myositis, pancreatitis, myocardial infarction, Infectious mononucleosis, Shock

Aspartate Aminotransferase (AST) 0-35u/L

- Found in very high concentrations within highly metabolic tissue (heart muscle , liver cells, skeletal muscle cells)
- Disease/injury of one of these tissue causes lying of cells and release into bloodstream
- Elevation proportional to # of cells injured
- Used for evaluation of patients with suspected hepatocellular diseases
- **High**- Liver disease, skeletal muscle trauma
- **Low**- Acute renal disease, Beriberi, Diabetic ketoacidosis, Chronic renal dialysis

Bilirubin
0.3-1mg/dl

- Used to evaluate liver function, part of the evaluation of adult patients with hemolytic anemia and newborn jaundice
- End product of RBC metabolism
- Component of bile
- Consists of conjugated (direct) and unconjugated (indirect) bilirubin
- Jaundice occurs when total bilirubin is greater than 2.5 mg/dL

Unconjugated bilirubin 0.02-0.08mg/dl

- Measures level of indirect bilirubin in blood

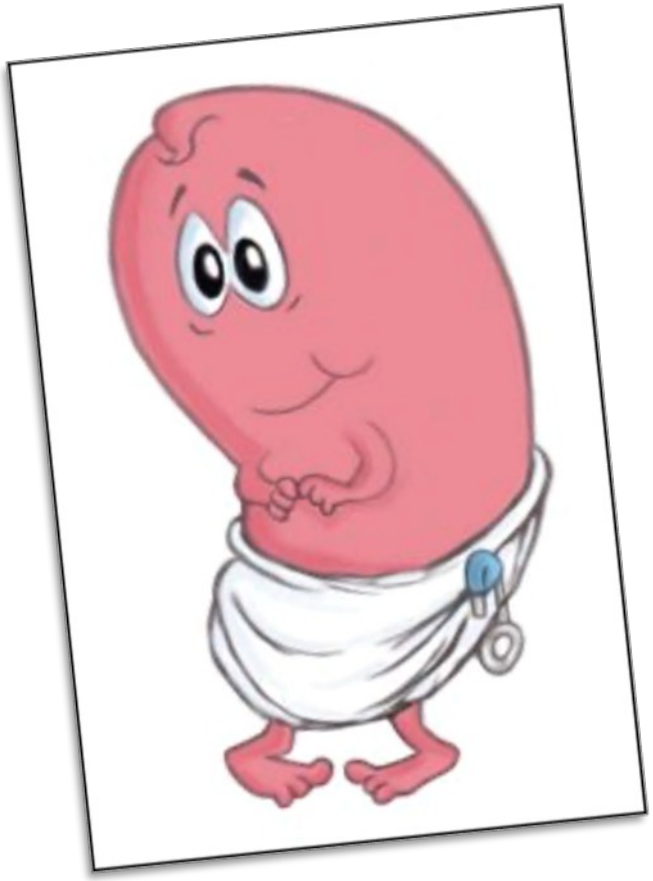
- **High**- erythroblastosis fetalis, transfusion reaction, sickle cell anemia, hemolytic jaundice, hemolytic anemia, hemolytic anemia, pernicious anemia, large-volume blood transfusion, large hematoma resolution, hepatitis, cirrhosis, sepsis, neonatal hyperbilirubinemia, Crigler-Najjar syndrome, Gilbert Syndrome

Conjugated Bilirubin
0.1-0.3 mg/dl

- Measures level of direct bilirubin in blood

- **<u>High</u>**- gallstone, extra-hepatic duct obstruction, extensive liver mets, cholestasis from drugs, Dubin- Johnson syndrome, Rotor Syndrome

Kidney Function



Kidney Waste

- BUN

  Liver produces → Blood → Kidney →

- Creatinine
  - BEST MEASURE
  - Muscle breakdown
  - CrCl- amount of blood cleared of Cr in one minute

- GFR
  - Not definitive
  - Not accurate for Obese pts, Amputees, Supplement users

BUN (Blood Urea Nitrogen) 10-20 mg/dl

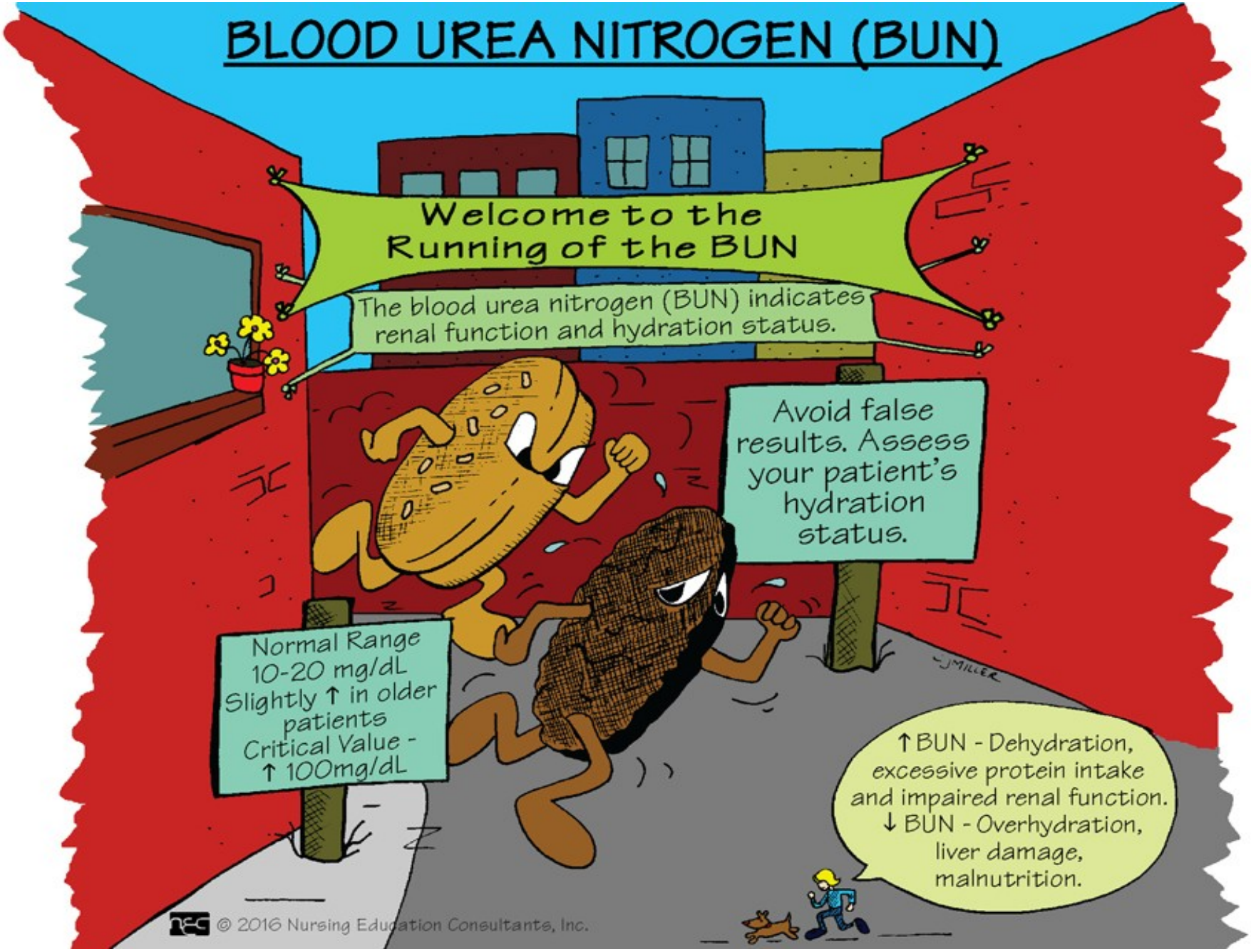
- Measures urea nitrogen in blood- used for kidney and liver function
- End product of protein metabolism (produced in liver)
- Indirect and rough measurement of renal function and glomerular filtration rate
- Measure of liver function

BUN

- High- Pre- renal
- Hypovolemia, shock, burns, dehydration, CHF, MI, GI bleed, excessive protein ingestion, starvation, sepsis
- Renal-
- Glomerulonephritis, pyelonephritis, acute tubular necrosis, renal failure, nephrotoxic drugs
- Post renal-
- Ureteral obstruction from stones, tumor, congenital anomalies, bladder outlet obstruction for BPH, cancer or bladder/ urethral congenital anomalies

BUN

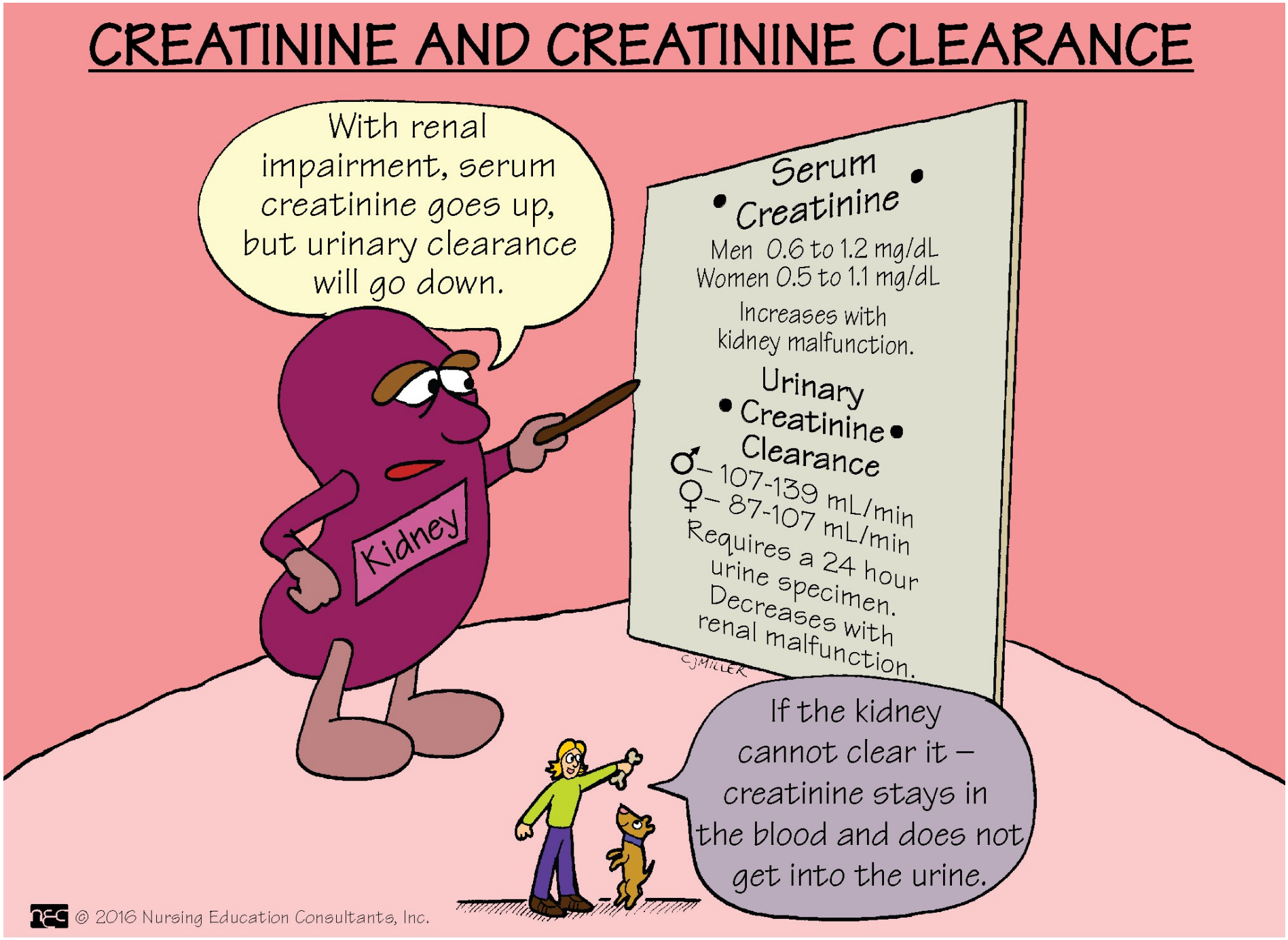
- Low- liver failure, over hydration, negative nitrogen balance, pregnancy, nephrotic syndrome


BLOOD UREA NITROGEN (BUN)
Welcome to the Running of the BUN
The blood urea nitrogen (BUN) indicates renal function and hydration status.
Avoid false results. Assess your patient's hydration status.
Normal Range
10-20 mg/dL
Slightly ↑ in older patients
Critical Value -
↑ 100mg/dL
↑ BUN - Dehydration, excessive protein intake and impaired renal function.
↓ BUN - Overhydration, liver damage, malnutrition.
J MILLER
© 2016 Nursing Education Consultants, Inc.

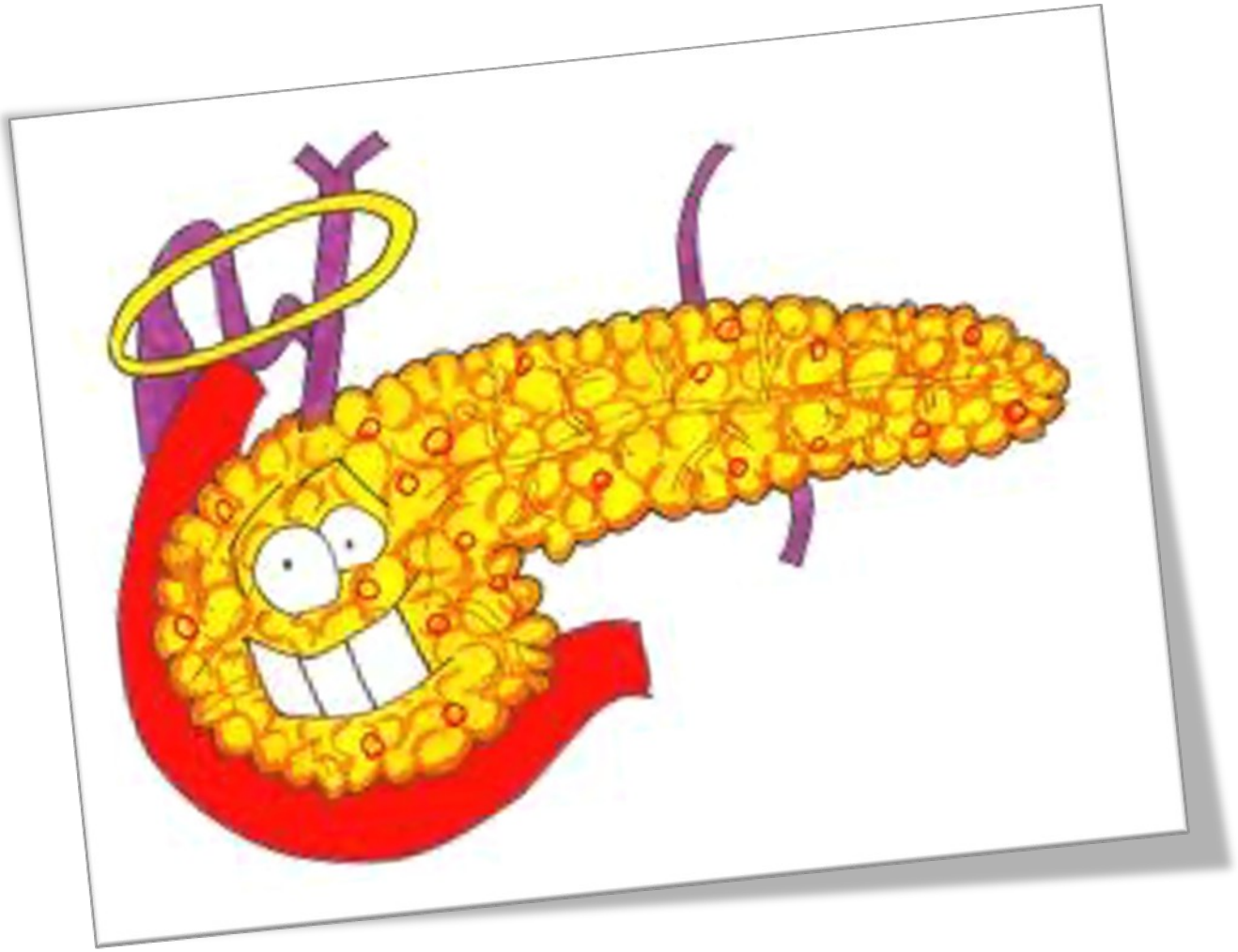
Creatinine
0.5-1.1 mg/dl

- Excreted entirely by kidneys so direct measure of renal function
- Minimally affected by liver function
- Critical- > 4mg/dL
- **High-** diseases affecting renal function, CHF, dehydration, Rhabdomyolysis, diabetic nephropathy, acromegaly, gigantism
- **Low-** debilitation , decreased muscle mass

CREATININE AND CREATININE CLEARANCE



Pancreas



Pancreas Specifics

- Detect/monitor pancreatitis
- Amylase
- Lipase

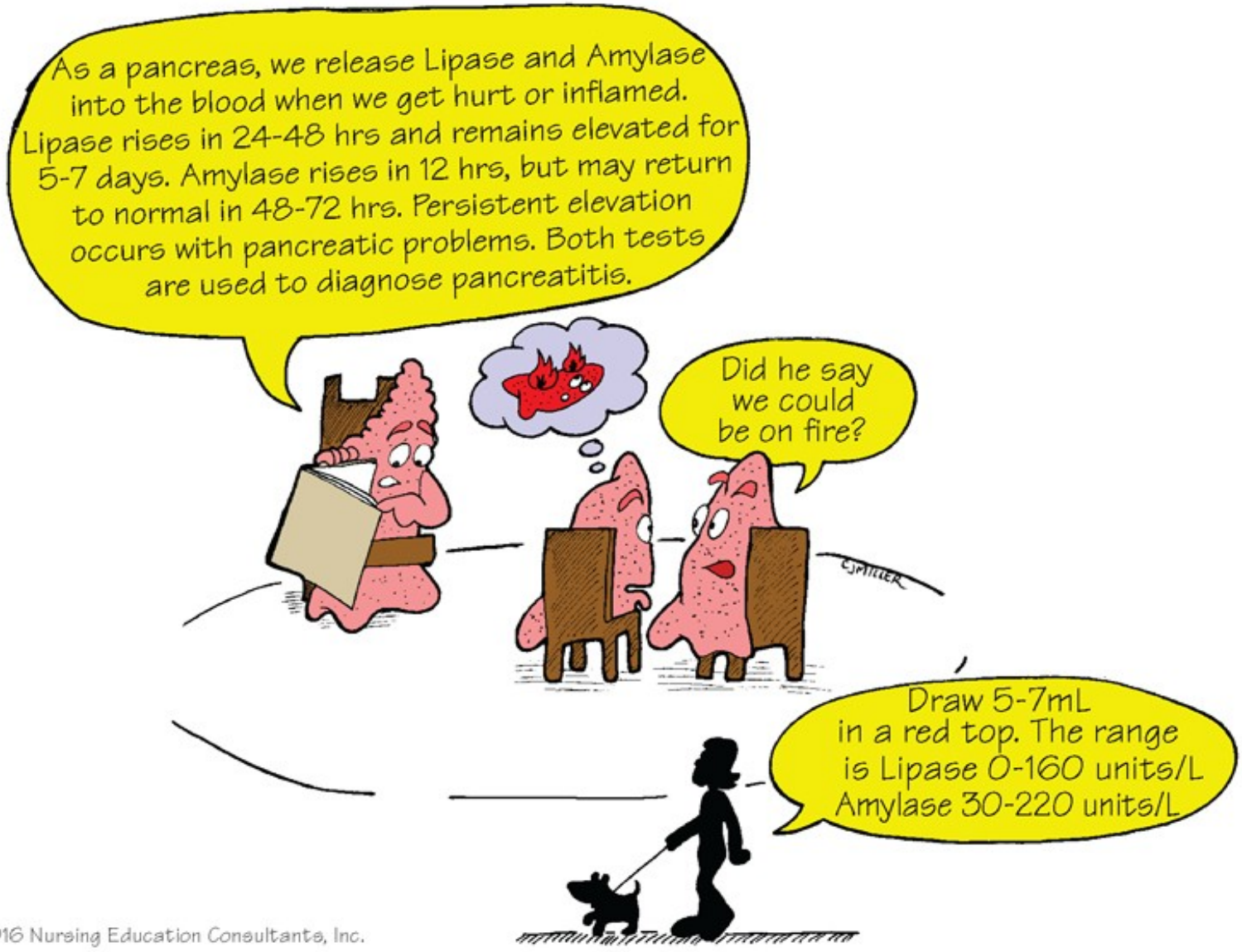
Amylase
< 130 U/L

- Pancreatic test that is helpful in the evaluation of abdominal pain
- Elevated levels
- Many abdominal diagnoses, DKA, various cancers, salivary gland inflammation
- Decreased levels
- Hepatic necrosis, advanced chronic pancreatitis

Lipase
< 160 U/L

- Enzyme secreted by pancreas into small intestines
- Helps in the breakdown of triglycerides into fatty acids
- Highly specific for pancreatic diseases, more so than amylase
- Elevated levels
- Acute pancreatitis, early pancreatic cancer, perforated ulcer
- Decreased level
- Acute severe pancreatitis

LIPASE AND AMYLASE (SERUM)



Urine Studies

Common indications for Urinalysis

- Dysuria, Flank pain
- Fluid balance
- Kidney status
- Liver function
- Fever
- Change of mental status in the elderly or handicapped
- Hematuria

Interpretation of results

Color

- Over hydration
- ETOH
- Diuretics
- Nephritis
- Dehydration
- Blood
- Drugs
- Foods

Appearance

- Clear
- Cloudy
- Red

Interpretation of results

Glucose

- Hyperglycemia
- Renal tubule disease
- Cushing's disease
- Stress
- Heavy meals

Ketones

- Diabetes
- Starvation/fasting
- Vomiting
- Acute illness
- ETOH
- Reduced carb intake

Interpretation of results

Bilirubin

- Hepatitis
- Liver dz
- Biliary obstruction

- **Specific Gravity**
- Hydration status
- Radiopaque dye
- Renal Disease

Blood

- Hemoglobinuria
- Myoglobinuria
- Hematuria
- Kidney stones

- **pH**
- Acidic
- alkalotic

Interpretation of results

Protein

- Kidney dz
- Hypertension
- Chronic UTI's
- Fever/Infection
- Trauma
- Pre-eclampsia
- Diabetes
- Poisonings
- Leukemia

Urobilinogen

- RBC destruction
- Liver damage
- Biliary obstruction

Nitrate

- Significant bacteria

Interpretation of results

Leukocytes (WBC)

- Bacterial infection
- Renal disease
- Fever
- Exercise
- Appendicitis
- Bladder tumors

Bacteria

- UTI

UA (Urinalysis)

- 3 PARTS
  - Gross
  - Dipstick
  - Microscopic

Urinary Analysis (UA)

- Provides information about kidneys and other metabolic processes
- Used for diagnosis, screening and monitoring
- Frequently used to test for urinary tract infections (UTIs)

UA Normal Values

- Appearance: clear
- Color: amber yellow
- Odor: aromatic
- pH:4.6-8
- Protein: 0-8 mg/dL
- Specific gravity: 1.005-1.030
- Leukocyte esterase: negative
- Nitrites: none
- Ketones: none

UA Normal Values cont.

- Bilirubin: none
- Urobilinogen: 0.01- 1 Ehrlich unit/ml
- Crystals: none
- Casts: none
- Glucose: negative
- White Blood cells: 0-4/low-power field
- WBC cast: none
- Red Blood Cells(RBCs): < 2
- RBC casts: none

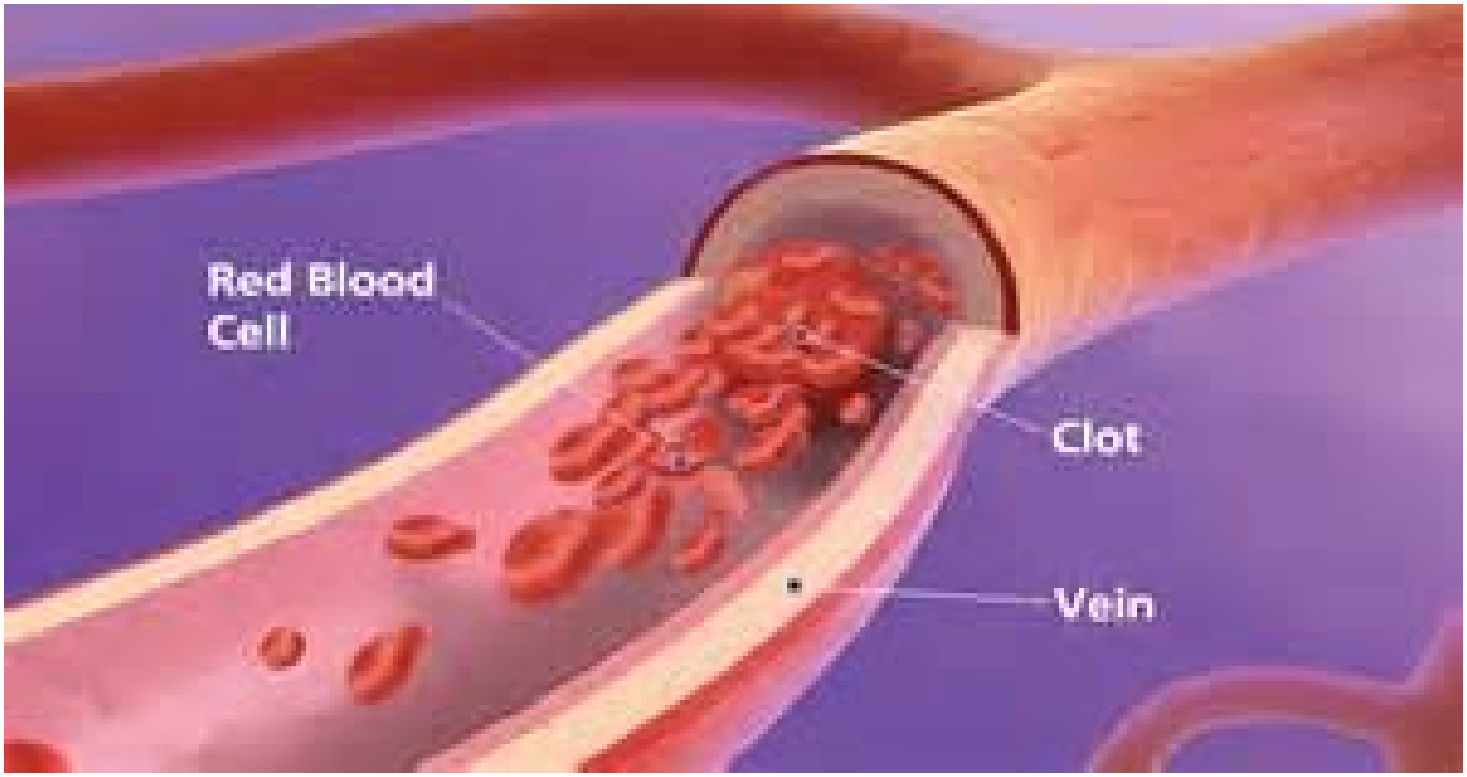
24 hr Urine

- Pt to void. Discard the 1st voiding.
- Start time for 24 hr test.
- All urine saved in container for 24hr
- Pt voids at end of 24 hrs. End of test.
- Sources of error:
  - Contaminants in urine
  - Failure to collect all urine in time period
  - Including 1st voided urine
  - Improper storage/preservation of specimen

Urinary Protein

- Used to monitor kidney function
- Normally not present in normal kidney due to size barrier in glomerulous
- Normally tested by dipstick method, quantification requires 24-hour urine collection
- Presence (proteinuria) can indicate nephrotic syndrome, multiple myeloma or complications of DM, glomerulonephritis, amyloidosis

Clotting Labs



Common Indication for Clotting Factors

- Monitor the effectiveness of anticoagulation therapy
- Evaluate bleeding
- Evaluate liver function

Clotting Factors

- PT- Protime 11-13 secs

- Anti-Xa heparin monitoring system:
  Unfractionated: 0.35-.70 U/ml
  Low molecular weight: 0.40-1.10 U/ml

- INR- International Normalized ratio 1.0-1.5

PT & INR

Prothrombin Time

- Range: 11.0-12.5 sec.
- Critical > 20 sec.

International Normalizing Ratio

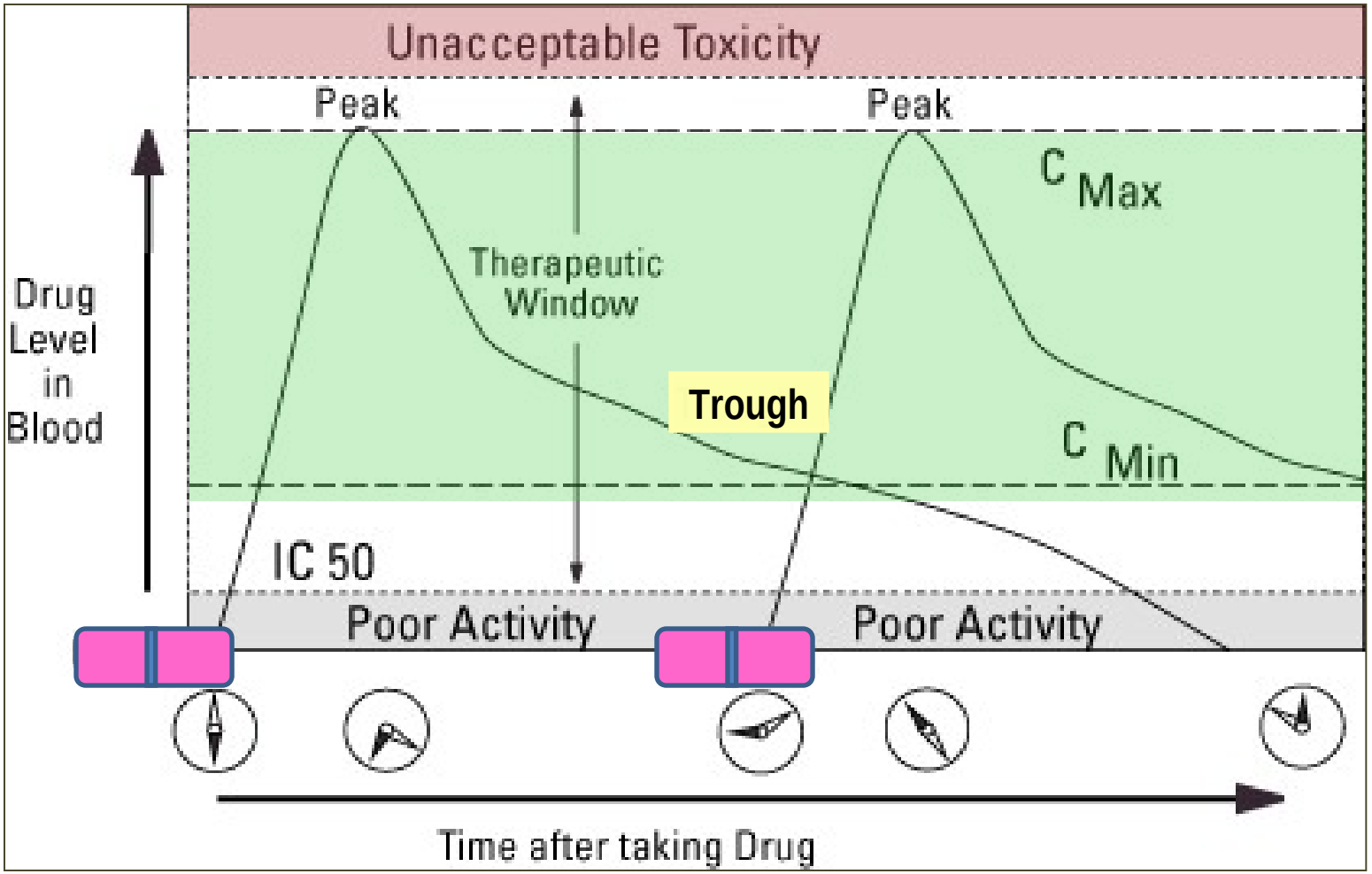
- Range: 0.8 – 1.1 sec. w/o Coumadin
- Critical: > 5.5

Coumadin = **P**ILLS **T**AK**IN** **R**EGULARLY

DRUG SPECIFICS

- Vancomycin
- Heparin
- Coumadin

Drug Monitoring



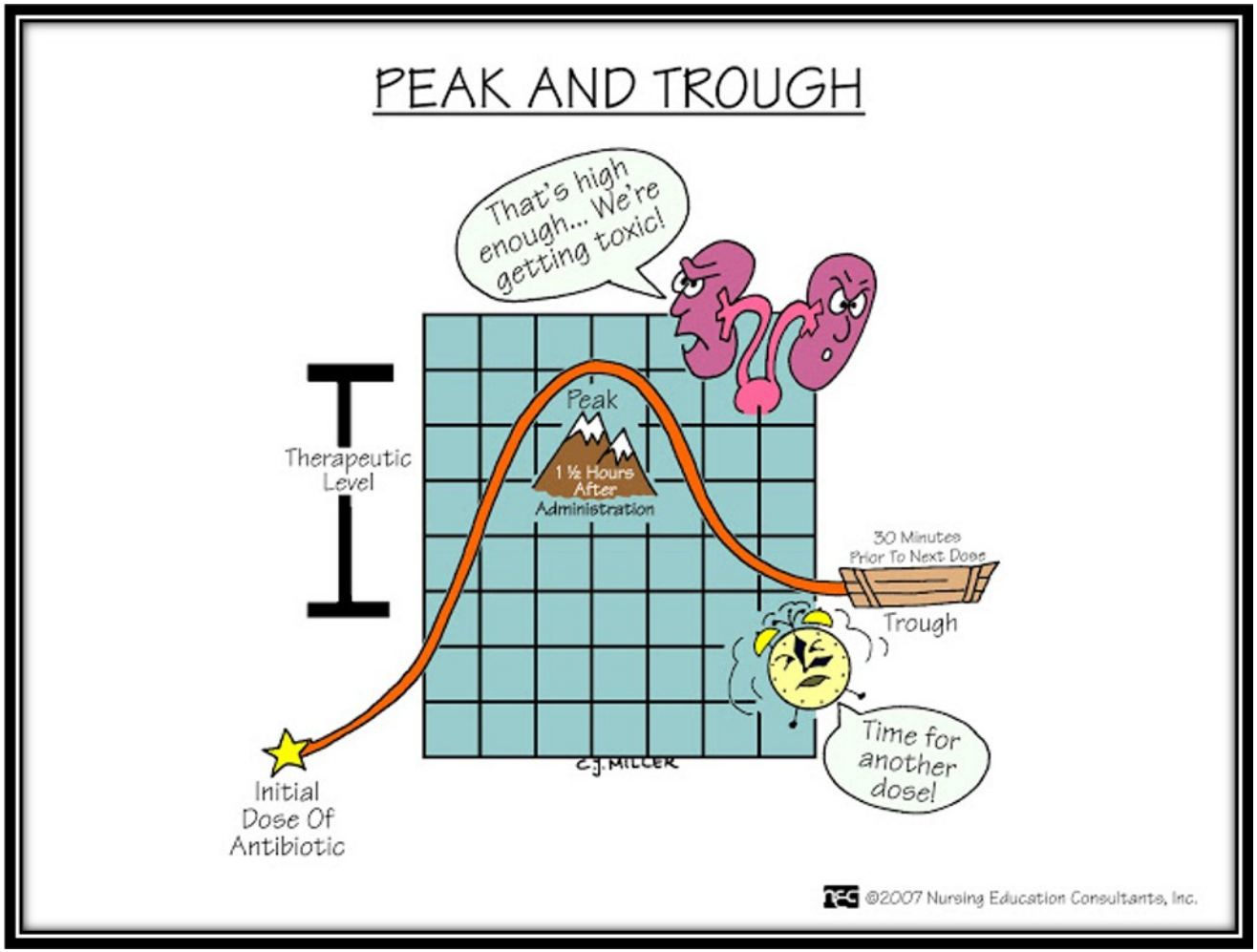
http://www.thebody.com/content/art13513.html

Peak & Trough: *Example*

- Order:
  - Vancomycin 1 Gram IV every 12 hrs
  - P & T with 3rd dose

Day 1	**Day 1**	**Day 2**
0900 (#1)	**2100 (#2)**	**0900 (#3) P&T** *0830 T _____* *Infusion complete at 1000* *1130 P _____*
Trough level 30 min prior to dose; if results OK then give medication **Peak** level 1 1/2 hrs after IVPB infusion complete		

Peak and Trough- Drug monitoring



Infectious Organisms

Culture & Sensitivity

- Urine, blood, wound drainage , tissue & devices
- Obtain specimen PRIOR to abx therapy
- Preliminary report - 24 hrs
- Final report – 72 hrs
- "no growth in 24 or 48 hours" – usually no infection.
- Culture for fungus - may take 6 wks
- Culture may be done after therapy to assess further treatment needed

Blood Cultures

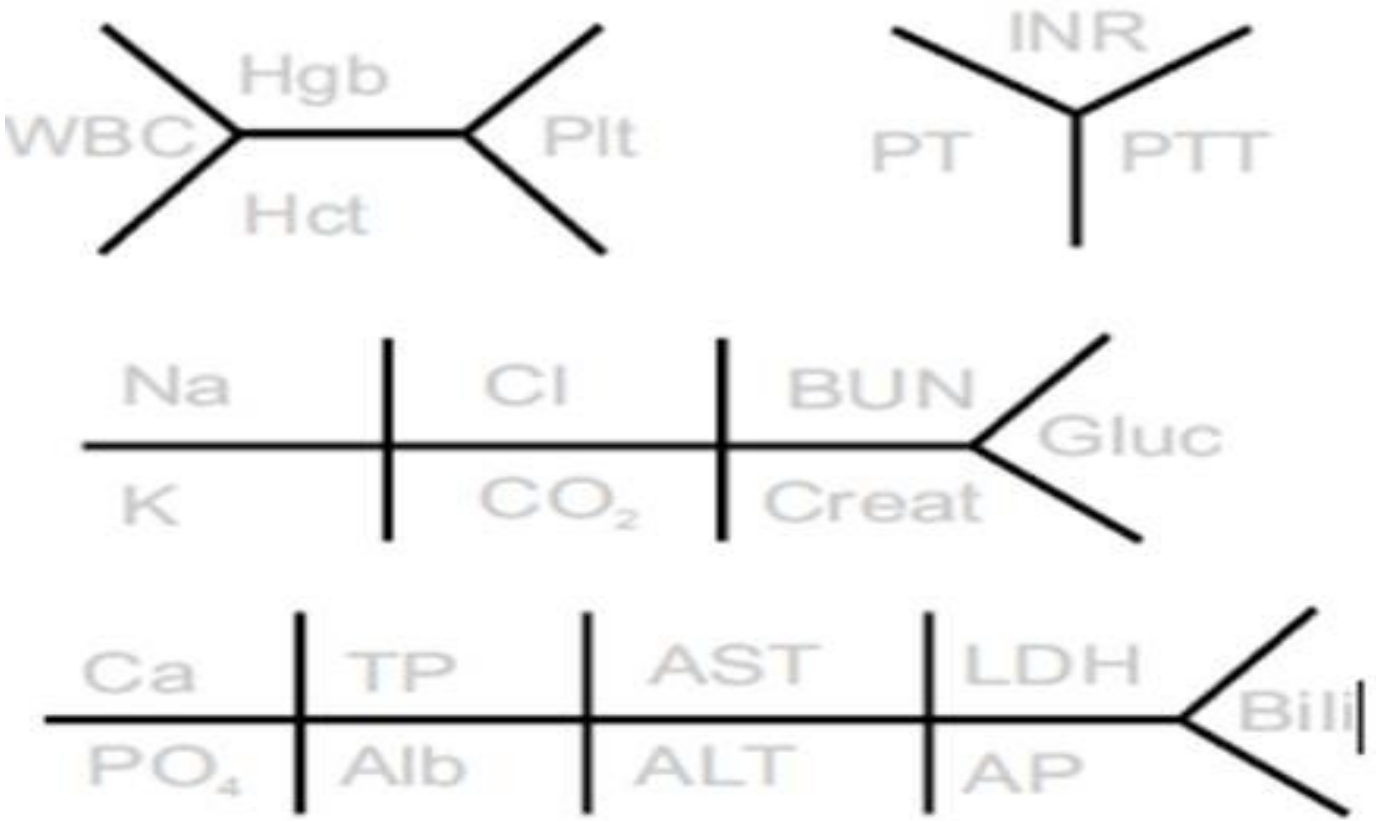
- Always collected first
- Site preparation & aseptic techniques
- Obtain 2 separate BC from 2 different sites
- Venipuncture preferred over central line site
- Aerobic or Anaerobic vial 1st ?

BLOOD CULTURES

- ☑ Draw when temperature is rising.
- ☑ Collect before starting antibiotics.
- ☑ Clean skin per protocol.
- ☑ Do not draw specimen from an IV line.
- ☑ Draw 2 culture specimens from 2 different sites.
- ☑ Draw 10-15 mL of blood.
- ☑ Label specimen with patient, name, date, time.
- ☑ Send specimen to lab immediately.

CJMILLER

http://allnurses.com/attachments/fishbone-from-pdf--10496d1332985271



- Resources for lecture
  - Pagana, K., & Pagana, T. J. (2014). *Mosby's Manual of Diagnostic & Laboratory Tests* (5th ed.). St. Louis: Mosby.