1) Protein, in plasma of a normal animal, constitutes approximately what percentage?

  A. 12
  B. 3
* C. 7
  D. 20

  Plasma, which serves to distribute nutrients and heat while collecting waste products consists of the following 90% water 7% protein (primarily produced by liver)
Albumin (
 60%): Maintains osmotic pressure Globulins (
 35%): Transport proteins (a,ß), antibodies (?)
Clotting Proteins (
 5%) - Help in coagulation 3% other solutes
Nitrogenous solutes (e.g. urea)
Nutrients (e.g. glucose)
Electrolytes (e.g. Na+)
Respiratory gases (e.g. O2)

2) Normal blood cells of birds could be described as follows :

  A. Anucleate, oval erythrocytes; thrombocytes; neutrophils, eosinophils, basophils; lymphocytes, monocytes, azurophils
  B. Nucleate, oval erythrocytes; thrombocytes; heterophils, eosinophils, basophils; lymphocytes, monocytes, azurophils
  C. Anucleate, biconcave erythrocytes; thrombocytes; heterophils, eosinophils, basophils; lymphocytes, monocytes
* D. Nucleate, oval erythrocytes; thrombocytes; heterophils, eosinophils, basophils; lymphocytes, monocytes

  Mammalian blood cells are anucleate, biconcave (oval in camelidae) erythrocytes; platelets; neutrophils, eosinophils, basophils; lymphocytes, monocytes.<p>Reptilian blood is very similar to the blood of birds (indicating a strong link between the two). However, it also contains azurophils (similar to monocytes, but stain differently) in addition to all the bird blood cells.

3) Hematopoiesis, the development of blood cells occurs

  A. Prenatally, in the yolk sac and bone marrow; in adults, in the liver
  B. Prenatally, in the spleen; in adults, in the bone marrow
* C. Prenatally, in the yolk sac and liver; in adults, in the bone marrow
  D. Prenatally, in the liver; in adults, in the liver and bone marrow

  Hematopoiesis is the development of blood cells. Prenatally, hematopoiesis occurs in the yolk sac, then liver. In normal adults it occurs in bone marrow. <p>Complex cellular and humoral interactions regulate proliferation, differentiation and maturation of each cell types. <p>Pools of progenitor cells originate from bone marrow stem cells. <p>Further lineage commitment depends on the variety of growth factors or colony stimulating factors. <p>

4) The precursor of red blood cells is

  A. Lymphoid Colony Forming Unit
* B. Erythoid Burst Forming Unit
  C. CFU-GM
  D. BFU-Meg

  The stages in development of a red blood cell are described below :<p><img src="erythropoiesis

  A. Burst forming units
  B. Both Colony and Burst forming units
* C. Colony forming units
  D. Neither Colony or Burst forming units

  BFUs are relatively erythropoietin insensitive - their number changes very slightly following bleeding or hyper-transfusion (when kidneys increase synthesis of erythropoietin). CFUs, on the other hand are very responsive to erythropoietin, with numbers increasing markedly in blood loss anemia but decreasing sharply after hyper-transfusion. <p>Erythropoietin or EPO is a glycoprotein hormone that is a cytokine for erythrocyte (red blood cell) precursors in the bone marrow. Also called hematopoietin or hemopoietin, it is produced by the kidney (liver in fetuses), and is the hormone regulating red blood cell production targeting erythroid progenitors and maturing nucleated red cells <p>Erythropoietin is available as a therapeutic agent produced by recombinant DNA technology in mammalian cell culture. It is used in treating anemia resulting from chronic renal failure or from cancer chemotherapy. Its use is also believed to be common as a blood doping agent in endurance sports such as bicycle racing, tria

6) Reticulocytes are

  A. The same size as erythrocytes
* B. Larger than erythrocytes
  C. Smaller than erythrocytes
  D. formed from erythrocytes that are ageing

  Reticulocytes are immature red blood cells, typically composing about 1% of the red cells in the human body. Reticulocytes develop and mature in the red bone marrow and then circulate for about a day in the blood stream before developing into mature red blood cells. Like mature red blood cells, reticulocytes do not have a cell nucleus. <p>They are called reticulocytes because of a reticular (mesh-like) network of ribosomal RNA that becomes visible under a microscope with certain stains such as new methylene blue. <p>Reticulocytes appear slightly bluer than other red cells when looked at with the normal Romanowsky stain. Reticulocytes are also slightly larger, which can be picked up as a high MCV (mean corpuscular volume) with a full blood count done by machine. <p>Most reticulocytes are retained in the marrow until they mature to erythrocytes. In severe acute regenerative anemia, metarubricytes (nucleated blood cells) may enter the blood along with reticulocytes.<p><img src="erythropoiesis.jpg">

7) When interpreting reticulocyte count, which of the following statement is INCORRECT?

* A. Anemic horses show a dramatic increase in reticulocytes in circulating blood with even mild anemia
  B. In cats, mild anemia results in only punctate reticulocytes being released from marrow. These persist in the blood for 10- 12 days.
  C. In anemic ruminants, reticulocytes are released into the blood stream in proportion to the severity of anemia
  D. Aggregate reticulocytes (in cats) are larger and more immature than punctate reticulocytes

  Even in severely anemic horses, reticulocytes are rarely released from the marrow to circulate in blood; therefore, a reticulocyte count is rarely done in horses.<p>Punctate reticulocytes have minute points on the surface.

8) Most of the destruction of red blood cells occurs in the

  A. Liver
* B. Spleen
  C. Lymph nodes
  D. Intestine

  Macrophages in the spleen ingest old RBCs. Heme is catabolized by an enzyme heme-oxygenase to produce Iron and Biliverdin. Biliverdin is reduced to bilirubin which is released into the circulation where it binds with the carrier protein, albumin. In the liver, bilirubin is dissociated from albumin before entering hepatocytes, where it is conjugated to uridine diphosphoglucuronide to form bilirubin-diglucuronide. Conjugated bilirubin is excreted into the intestine (in bile) where it is reduced to urobilinogen (and stercobilinoge by bacterial action, most of which is resorbed and returned to the liver (entero-hepatic circulation), while the rest (stercobilongen, as stercobilin) is excreted in feces. Trace amounts of urobilinogen are normally detected in urine.<p>

9) The key trigger for increased Erythropoietin (EPO) production in the kidney is :

  A. Increased carbon dioxide in blood
  B. Reduced hematocrit
  C. Reduced red blood cell count
* D. Hypoxia

  Hypoxia, which can be caused by a variety of conditions including anemias, cardiopulmonary disease, hemoglobinopathies and blood volume decrease, is what triggers increased EPO production in the adult kidney (liver in fetuses). <p>Erythropoietin or EPO is a glycoprotein hormone that is a cytokine for erythrocyte (red blood cell) precursors in the bone marrow. Also called hematopoietin or hemopoietin, it is produced by the kidney (liver in fetuses), and is the hormone regulating red blood cell production targeting erythroid progenitors and maturing nucleated red cells <p>Erythropoietin is available as a therapeutic agent produced by recombinant DNA technology in mammalian cell culture. It is used in treating anemia resulting from chronic renal failure or from cancer chemotherapy. Its use is also believed to be common as a blood doping agent in endurance sports such as bicycle racing, triathlons and marathon running.

10) The hormonal influence on the production of erythropoietin is carried out by

  A. Pituitary, thymus, parathyroid and adrenal
  B. Pituitary, liver, kidney and adrenal
  C. Adrenal, thyroid, gonads and pancreas
* D. Pituitary, adrenal, thyroid and gonads

  The pituitary, adrenal, thyroid and gonads participate in the regulation of erythropoiesis by regulating erythropoietin production by the kidney. <p>Androgens, TSH, ACTH, growth hormone, prolactin, cortisone, thryroxin, epinephrine, norepinephrine and angiostensin stimulate erythropoiesis. <p>Estrogen and excessive glucagon exert inhibitory action on erythropoiesis. <p>RBC counts are slightly higher in most of the mammalian males compared with females. RBC count increases in females following ovariectomy and decreases in males following castration.

  A. abnormal aggregations of RNA that usually only stains with new methylene blue, usually caused by heavy metal poisoning.
* B. particles of denatured hemoglobin protein that may be caused by oxidant drugs and chemicals
  C. an indicator of regenerative anemia
  D. nuclear remnants observed in young erythrocytes

  <p><img src="Heinz-body.jpg"><p>Heinz bodies (also referred to as "Heinz-Erhlich bodies") are inclusions within red blood cells composed of denatured hemoglobin. They are named after Robert Heinz (1865-1924) a German physician, who in 1890 described these inclusions in connection with cases of hemolytic anemia (the abnormal breakdown of red blood cells). <p>Heinz bodies are formed by damage to the hemoglobin component molecules, usually through oxidations, which causes the damaged molecules to precipitate and damage the cell membrane. Damaged cells are attacked by macrophages in the spleen, where the precipitate and damaged membrane is removed, leading to characteristic "bite cells". The denaturing process is irreversible and the continual elimination of damaged cells leads to Heinz body anemia. <p>Heinz bodies are especially associated with the consumption of onions by cats, dogs, and various primates. Thiosulfate compounds in the flesh of onions have been identified as the cause.<p>Heinz bodies

12) Howell-Jolly bodies in erythrocytes :

  A. are particles of denatured hemoglobin protein that may be caused by oxidant drugs and chemicals
  B. may be observed in 2-3% of the erythrocytes of normal cats.
* C. are nuclear remnants observed in young erythrocytes
  D. are abnormal aggregations of RNA that usually only stains with new methylene blue, usually caused by heavy metal poisoning.

  A few Howell-Jolly bodies are often observed in red cells of cats and horses. They can be observed in regenerative anemias of most animals. They may be observed in splenic disease, since the spleen normally removes HJ bodies from red cells.<p><img src="Howell-Jolly-bo

13) Basophilic stippling of erythrocytes

* A. are abnormal aggregations of RNA that usually only stains with new methylene blue, often caused by heavy metal poisoning.
  B. may be observed in 2-3% of the erythrocytes of normal cats.
  C. are particles of denatured hemoglobin protein that may be caused by oxidant drugs and chemicals
  D. are nuclear remnants observed in young erythrocytes

  <p><img src="Basophilic-Stippling.jpg"><p>Basophilic stippling can be observed in heavy metal poisoning in the presence of non-regenerative anemias. It is also seen during intense erythrogenesis in dogs, cats and ruminants along with polychromasia (faint bluish tint due to an admixture of the colors of hemoglobin and the basophilic erythrocyte cytoplasm).

14) Polychromasia of erythrocytes

  A. is a result of abnormal aggregations of RNA that usually only stains with new methylene blue, often caused by heavy metal poisoning.
  B. is a result of nuclear remnants observed in young erythrocytes
* C. is a faint bluish tint due to an admixture of the colors of hemoglobin and the basophilic erythrocyte cytoplasm.
  D. is a result of particles of denatured hemoglobin protein that may be caused by oxidant drugs and chemicals

  <p><img src="Polychromasia.jpg"><p>Polychromasia is a faint bluish tint of erythrocytes (and reticulocytes) due to an admixture of the colors of hemoglobin and the basophilic erythrocyte cytoplasm. Polychromasia is an indicator of regenerative anemia.

15) Hypochromasia of erythrocytes

  A. is a result of nuclear remnants observed in young erythrocytes
* B. is frequently observed in iron deficiency anemia as caused by chronic blood loss or parasitism
  C. is a result of abnormal aggregations of RNA that usually only stains with new methylene blue, often caused by heavy metal poisoning.
  D. is a faint bluish tint due to an admixture of the colors of hemoglobin and the basophilic erythrocyte cytoplasm.

  <p><img src="Hypochromasia.jpg"><p>Hypochromasia (reduced staining) manifests in erythrocytes with a decreased density of the characteristic hemoglobin color. It is frequently observed in iron deficiency anemia as caused by chronic blood loss or parasitism.

16) Polycythemia of erythrocytes

  A. is frequently observed in iron deficiency anemia as caused by chronic blood loss or parasitism
* B. is characterized by the presence of too many red cells in the circulation
  C. is a result of abnormal aggregations of RNA that usually only stains with new methylene blue, often caused by heavy metal poisoning.
  D. is a result of nuclear remnants observed in young erythrocytes

  Polycythemia is a condition in which there is a net increase in the total number of red blood cells in the body. The overproduction of red blood cells may be due to a primary process in the bone marrow (a so-called myeloproliferative syndrome), or it may be a reaction to chronically low oxygen levels or, rarely, a malignancy. Hematocrit and blood volume are increased.

17) Normocytic, microcytic and macrocytic are descriptions that are relevant when discussing

  A. Hematocrit
  B. MCH
  C. MCHC
* D. MCV

  <p><img src="MCV-histogram.gif">
Histogram and red cell parameters from a normal canine blood sample.<p>Mean corpuscular volume (MCV) is the mean volume of all the erythrocytes counted in a blood sample. <p>MCV = hematocrit ÷ rbc count <p>If the MCV is within the normal range, low or high then the cells are referred to as normocytic, microcytic or macrocytic, respectively. <p>Microcytic red blood cells are seen in iron deficiency anemia, lead poisoning and the genetic diseases. <p>Macrocytic red blood cells are associated with folic acid deficiencies. <p>Mean corpuscular hemoglobin (MCH) measures the average amount, or the mass, of hemoglobin present in each RBC while Mean corpuscular hemoglobin concentration (MCHC) measures the proportion of each cell taken up by hemoglobin.

18) If a blood sample statistic is reported in picograms, it could be reporting on which of the following?

  A. MCHC
  B. Hematocrit
  C. MCV
* D. MCH

  Mean corpuscular hemoglobin (MCH) measures the amount, or the mass (in picograms), of hemoglobin present in each RBC of a blood sample. (A picogram is one trillionth (10 ^ -12) of a gram). The weight of hemoglobin in an average cell is obtained by dividing the hemoglobin content by the total RBC count. <p>MCH (in picograms) = (hemoglobin [in g/dL] x 10 ÷ (rbc count [in millions/µL]) <p>This value is generally not useful because the combination of MCV and MCHC provides more specific information. For example, a low MCH could be due to smaller than normal cells with normal Hb concentration, or normal sized cells with lower than normal Hb concentration. It is better to know about cell volume and hemoglobin concentration directly.

19) A hypochromic erythrocyte has a low

  A. MCH
  B. MCV
  C. elasticity
* D. MCHC

  MCHC is the mean cell hemoglobin concentration, expressed in g/dL. It can be calculated from the [Hb] and the Hematocrit (synonymous with PCV) using the following formula: <p> MCHC [in g/dL] = hemoglobin [in g/dL] ÷ hematocrit [in L/L]. <p>The normal value for MCHC is about 33 g/dL. Red cell populations with values below the reference range can be termed "hypochromic". This can occur in strongly regenerative anemia, where an increased population of reticulocytes with low Hb content "pull" the average value down (an increased MCV would be expected under this scenario). Low MCHC can also occur in iron deficiency anemia, where microcytic, hypochromic red cells are produced as a result of the lack of iron to support hemoglobin synthesis. <p>Values for MCHC significantly above the reference range are not physiologically possible due to limitations on the solubility of Hb.<p>MCH (Mean corpuscular hemoglobin) is generally not useful because the combination of MCV and MCHC provides more specific information.

  A. Cytometric
  B. Biochemical
  C. Hypercytic
* D. Erythrokinetic

  Anemias are classified into 3 categories :
Cytometric (these depend on cell size and hemoglobin-content parameters, such as MCV and MCHC) : This can be Normocytic normochromic (normal size, normal hemoglobin concentration)
Macrocytic normochromic Macrocytic hypochromic Microcytic, hypochromic Microcytic normochromic Erythrokinetic (those that take into account the rates of rbc production and destruction) : Can be regenerative or non-regenerative
Biochemical (those that consider the etiology of the anemia at the molecular level) : based on Biochemical detection of the etiological agents (for example, iron deficiency anemia or hemolytic anemia (coomb’s test))
<p>For example, Sickle cell anemia would be classified as Cytometric classification: normochromic, normocytic Erythrokinetic classification: hemolytic Biochemical/molecular classification: DNA point mutation producing amino acid substi

  A. Storage reserve
  B. Proliferative
* C. Maturative
  D. Can belong to any of the phases, depending on its maturity

  <img src="Band-neutrophils.jpg"><p>Neutrophils and their precursors within the intramedullary phases (i.e. within the bone marrow) are loosely divided into the following 3 pools
Proli pool - myeloblasts, promyelocytes, myelocytes
Maturative pool - metamyelocytes, band cells
Storage pool - mature neutrophils.
<p> Neutrophil granulocytes, generally referred to as neutrophils, are the most abundant type of white blood cells and form an integral part of the immune system. Their name arises from staining characteristics on hematoxylin and eosin (H&E) histological preparations. Whereas basophilic cellular components stain dark blue and eosinophilic components stain bright red, neutrophilic components stain a neutral pink. These phagocytes are normally found in the blood stream. However, during the acute phase of inflammation, particularly as a result of bacterial infection, neutrophils leave the vasculature and migrate toward the site of inflammation in a process called che

22) Neutrophils that have been released into circulation can be within the "circulating pool" or the "marginal pool". The marginal pool consists of neutrophils marginated

  A. within the spleen
  B. within the kidney
  C. within the liver
* D. along the walls of capillaries

  Neutrophils are marginated along capillary walls. Margination occurs throughout the microvasculature but primarily in the lungs and to a relatively negligible extent in the spleen and liver. <p>The circulating pool refers to neutrophils actually in circulation. <p>Neutrophilia (increase in circulating neutrophils) can be caused by decreased neutrophil margination due to steroid administration, exercise, epinephrine administration, and other stressful situations (eg, trauma, severe pain): neutrophilia due to this cause is short lived (ie, minutes to hours, not days, in duration).

23) Band cells are seen in the developmental stage of the

  A. Red blood cell; during this stage the nucleus is not segmented
* B. Neutrophil; during this stage the nucleus is not segmented
  C. Eosinophil; during this stage the nucleus is segmented
  D. Basophil; during this stage the nucleus is 'banded'
  E. Neutrophil; during this stage the nucleus is segmented

  <p><img src="Band-neutrophils.jpg"> <p>Band cells or band neutrophils are those which have unsegmented nuclei. This is the developmental stage of the neutrophil (as well as the eosinophil and basophil) immediately preceding the mature segmented form. An increased proportion of bands in the peripheral blood is often referred to as a 'left shift' (this is to do with the graphical representation of the report), and may indicate the presence of infection. However, it is not particularly reliable in this regard, as other marrow 'stresses' may produce the same 'left-shift' effect.

24) Where referring to a blood sample, the term 'left shift' refers to

  A. the presence of excessive eosinophils
  B. neutrophilia
  C. the presence of excessive basophils
  D. neutropenia
* E. the presence of excessive immature neutrophils

<p>The term 'left shift' indicates that the neutrophils present in the blood are at a slightly earlier stage of maturation than usual (this is do with a left shift on a graphical report, actually). This is often seen in acute infections, when toxic granulation are seen. Early neutrophils are often referred to as 'band cells', because their nuclei are unsegmented. In severe infections, sometimes even myelocytes may appear in the blood. Other conditions, such as hypoxia and shock, can also cause a left shift.

25) Epinephrine causes

  A. Neutropenia, by reducing the marginal pool of neutrophils
  B. Neutrophilia, by increasing the release of neutrophils from bone marrow
* C. Neutrophilia, by reducing the marginal pool of neutrophils
  D. Neutropenia, by increasing the marginal pool of neutrophils

  An increased release of epinephrine or norepinephrine can cause transient neutrophilia (minutes to hours, not days, in duration). This neutrophilia is attributed to the increase in circulating pool as a consequence of decrease in the marginal pool and is called 'shift' or 'psuedo' neutrophilia because the size of the granulocyte pool remains unchanged. Stress is a major inducer of such transient neutrophilia.

  A. Left shift
* B. Gray Collie Syndrome
  C. White Collie Syndrome
  D. Right shift

  Canine Cyclic Neutropenia (Gray Collie Syndrome) is a stem cell disorder that occurs in collies. The result is a cyclic fluctuatian in blood cell numbers. Every 10 to 12 days the number of neutrophils drops dramatically, and then rebounds. There is an increased susceptibility to infection corresponding to the dip in neutrophil numbers. Affected dogs are subject to severe recurring bacterial infections, primarily of the respiratory or gastrointestinal tract. These dogs are also prone to bleeding episodes due to the drop in blood cells numbers. This is a serious genetic disorder. Even with the best of care, affected dogs rarely live beyond 2 or 3 years of age. <p>Puppies are usually smaller and weaker than their litter mates and by 8 to 12 weeks of age they develop clinical signs such as fever, diarrhea, joint pain, or other signs associated with eye, respiratory, or skin infections. The disease occurs in all gray (not merle) collies. No matter what color variation or type, all Collies have black noses EXCEPT

* A. Phagocytosis of bacteria
  B. Blood clotting
  C. Formation of pus
  D. Phagocytosis of viruses

<p>Neutrophil granulocytes, generally referred to as neutrophils, are the most abundant type of white blood cells and form an integral part of the immune system. Their name arrives from staining characteristics on hematoxylin and eosin (H&E) histological preparations. Whereas basophilic cellular components stain dark blue and eosinophilic components stain bright red, neutrophilic components stain a neutral pink. <p>Neutrophils are normally found in the blood stream. However, during the acute phase of inflammation, particularly as a result of bacterial infection, neutrophils leave the vasculature and migrate toward the site of inflammation in a process called chemotaxis. They are the predominant cells in pus, accounting for its whitish appearance. Neutrophils react within an hour of insult. <p>Neutrophils are active phagocytes , capable of ingesting microorganisms or particles. However, they can only execute one phagocytic event, expending all of their glucose reserves in an

28) Diapedesis is

  A. the final step in maturation of a monocyte into a macrophage
* B. the movement of leukocytes across the endothelial lining of blood vessels to interstitial fluid
  C. the process by which a bacterium is phagocytosed by a neutrophil
  D. a movement process that involved two "legs"

  Diapedesis is the movement of leukocytes across the endothelial lining of blood vessels to interstitial fluid (IF). The process is driven by chemotactic factors which serve to upregulate expression of adhesion molecules on the endothelial cells of postcapillary venules adjacent to the site of infection. Neutrophils, monocytes and NK cells use "roll-to-stop kinetics in order to slow down and "ooze through" (diapedesis) interendothelial spaces between endothelial cells and infiltrate the infected tissue. <p>Diapedesis usually happens when an area is injured or damaged and an inflammatory response is needed. This trafficking system is regulated by the background cytokine environment produced by the inflammatory response. In Leukocyte Adhesion Deficiency (LAD) there is defective integrin which impairs the ability of the leukocytes to stop and undergo diapedesis. Neutrophilia is a hallmark of LAD.<p> More, from Wikipedia

  A. anti-parasitical activity
  B. phagocytosis
  C. microbicidal activity
  D. anti-viral activity
* E. locomotion and chemotaxis

  <img src="bloodCells-2.jpg"><p>The main functional abnormalities seen in neutrophils are
Defects in locomotion and chemotaxis
'Lazy leukocyte' syndrome is related to decreased membrane deformability that results in abnormal interaction of membrane proteins and microfilaments Virus and bacteria infected neutrophils show decreased chemotaxis and locomotion Chediak-Higashi neutrophils have an underlying defect of microtubule assembly Neutrophils of neonates exhibit decreased chemotactic responsiveness because of developmental immaturity of the cells
Phagocytic defects
Phagocytic activity of the neutrophils is influenced by age of the individual, age of the neutrophil, disease states, drug therapy etc Diseases such as diabetes mellitus and some bacterial infections reduce phagocytic activity of neutrophils Certai antibiotics such as gentamycin, erythromycin, oxytetracyclin and chrolamphenicol in high concentration depress phago

  A. hours to days
  B. minutes to hours
  C. about the same as a neutrophil
* D. months to years

  <p><img src="Macrophage-in-action.jpg"><p>Macrophages are cells within the tissues that originate from specific white blood cells called monocytes. Monocytes and macrophages are phagocytes, acting in both nonspecific defense (or innate immunity) as well as specific defense (or cell-mediated immunity) of vertebrate animals. Their role is to phagocytize (engulf and then digest) cellular debris and pathogens either as stationary or mobile cells, and to stimulate lymphocytes and other immune cells to respond to the pathogen. <p> When a monocyte enters damaged tissue through the endothelium of a blood vessel (a process known as the leukocyte adhesion cascade), it undergoes a series of changes to become a macrophage. Macrophages are unable to divide. Macrophages are attracted to a damaged site by chemical substances through chemotaxis, triggered by a range of stimuli including damaged cells, pathogens, histamine released by mast cells and basophils, and cytokines released by macrophages already at

  A. macrophages
  B. basophils
  C. monocytes
  D. neutrophils
* E. eosinophils

  <img src="bloodCells-2.jpg"><p>Eosinophil granulocytes, commonly referred to as eosinophils (or less commonly as acidophils), are white blood cells that are responsible for combating infection by parasites in the body. They also have a rather diverse array of other functions, impacting multiple areas of immunology including allergy and asthma.<p> Eosinophils make up about 1-5% of the all white blood cells, and are about 10-12 micrometers in size. <p>The functions of eosinophils include the following : Phagocytosis and bactericidal effect : Less effective than neutrophils
Paraciticidal effect : Damage to the parasite is mediated by both oxidative and non-oxidative mechanisms within eosinophil granules that are passed on to antigen. Eosinophilia generally seen with parasitic infections. Regulation of allergy : inhibit mast cell release of histamine, regulate platelet aggregation and macrophage migration Regulation of inflammation : participate in acute inflammation, also con

32) The least common granulocyte is the

* A. basophil
  B. neutrophil
  C. eosinophil
  D. monocyte

  <img src="bloodCells.jpg"><p>Basophils are the least common of the granulocytes (i.e. the "phils" - neutrophil, basophil & eosinophil), representing about 0.5% to 1% of circulating leukocytes (monocytes are not granulocytes). <p>Basophils play a role in immune mediated inflammation, especially in analphylaxis and cutaneous hypersensitivity. Granules of basophils are rich in histamine, heparin, sertonin and hyaluronic acid. Basophils produce eosiniphilic chemotactic factor that attract eosinophils and neutrophils to the inflammed site. Recently, it was demonstrated that basophils are also involved in immune response against helminth (worm-like) parasites. <p>A low Basophil count with a low neutrophil count is almost always indicative of future leukemia. <p><a href="http://en.wikipedia.org/wiki/B Wikipedia reference

33) Petechia is defined as

* A. a minute red or purple spot as the result of tiny hemorrhages of blood vessels
  B. the escape of blood from ruptured blood vessels into the surrounding tissue to form a purple or black-and-blue spot
  C. a mass, such as an air bubble, a detached blood clot, or a foreign body, that travels in the bloodstream and lodges in a blood vessel, thus serving to obstruct or occlude such a vessel
  D. the final product of the blood coagulation step in hemostasis

  Ecchymosis is the purple or black-and-blue spot formed from the escape of blood from ruptured blood vessels into the surrounding tissue. <p>A thrombus, or blood clot, is the final product of the blood coagulation step in hemostasis. <p>An embolus is a mass, such as an air bubble, a detached blood clot, or a foreign body, that travels in the bloodstream and lodges in a blood vessel, thus serving to obstruct or occlude such a vessel.

34) Primary hemostasis is the

  A. formation of a fibrin clot
  B. formation of a platelet plug stabilized by fibrin
* C. formation of the platelet plug
  D. process that creates pus around a splinter

  When a blood vessel is wounded, several steps occur to staunch the flow of blood, namely: Primary Hemostasis : Vasoconstriction constricts the blood vessel, minimizing vessel diameter and slowing bleeding. Platelets, one of the formed elements of the blood, bind to collagen in the exposed walls of the blood vessel to form a hemostatic plug within seconds after an injury.
Secondary hemostasis or coagulation occurs. This involves a complex cascade of coagulation factors, ultimately resulting in the transformation of fibrinogen, a blood protein, into polymerized fibrin, making a clot. This process takes several minutes.
Tertiary hemostasis : The clot attracts and stimulates the growth of fibroblasts and smooth muscle cells within the vessel wall, and begins the repair process which ultimately results in the dissolution of the clot (fibrinolysis).
<
Disorders of hemostasis can be roughly divided into platelet disorders, such as idiopathic thrombocytopenic pur

35) With respect to primary hemostasis, which of the following statements is FALSE?

* A. Fibrin binds to receptor, GPIIb-IIIa, effectively crosslinking platelets to form a platelet plug
  B. When platelets bind to von Willebrand factor, the shape change induced activates the platelet membrane integrin receptor, GPIIb-IIIa
  C. When endothelial cell injury occurs, platelets adhere to von Willebrand factor (vWf) in the subendothelium via the platelet membrane receptor GPIb-IX
  D. During platelet activation, thromboxane A2 recruits and activates other platelets, thus promoting aggregation
  E. Under normal physiologic conditions, hemostasis is prevented by the endothelium, which provides a physical barrier and secretes platelet inhibitory products, such as prostacycline (PGI2) and nitric oxide (NO)

  <img src="Primary-Hemostasis.gif"><p>Following endothelial cell injury, primary hemostasis involves the following steps
Platelets adhere to von Willebrand factor (vWf) in the subendothelium via the platelet membrane glycoprotein receptor GPIb-IX.
This adhesion activates platelets, causing a shape change, activating platelet membrane integrin receptor, GPIIb-IIIa.
Fibrinogen binds to this receptor, effectively crosslinking platelets to form a platelet plug
Platelet activation also causes release of thromboxane A2, which recruits and activates other platelets, thus promoting aggregation. In addition, phosphatidylserine provides an essential binding site for activated coagulation factors, optimizing activation of the coagulation cascade and the formation of fibrin.
Fibrin is incorporated into the growing platelet plug to form a stable thrombus.

36) With regards to secondary hemostasis, which of the following statements is FALSE?

  A. The role of platelets is to provide a source of phospholipid [PF3] and a binding surface upon which the coagulation cascade can proceed
* B. Fibrin adheres to von Willebrand factor (vWf) in the subendothelium via the platelet membrane receptor GPIb-IX
  C. Calcium is critical for secondary hemostasis
  D. It involves circulating coagulation factors, which act as enzymes [which require activation] and cofactors (factors V and VIII), calcium and platelets
  E. It is defined as the formation of fibrin through the coagulation cascade
  F. It is responsible for stabilizing the soft clot and maintaining vasoconstriction

  <img src="Coagulation-Cascade.jpg"><p>It is during primary hemostasis that fibrin adheres to von Willebrand factor (vWf) in the subendothelium via the platelet membrane receptor GPIb-IX. <p>Secondary Hemostasis is separated into 3 pathways
The Extrinsic pathway - involves Tissue factor and factor VII complex, which activates factor X in the presence of Ca++
Intrinsic pathway - involves high-molecular weight kininogen, prekallikrein, and factors XII, XI, IX and VIII. Factor VIII acts as a cofactor (with calcium and platelet phospholipid) for the factor IX-mediated activation of factor X.
The Common pathway involves the factor X-mediated generation of thrombin from prothrombin (facilitated by factor V, calcium and platelet phospholipid). Thrombin, in the presence of Ca++, stimulates the production of soluble fibrin from fibrinogen.
<
K is necessary for normal clotting of blood. Specifically, vitamin K is required for the liver to make

37) With regards to Tertiary Hemostasis, which of the following statements is FALSE?

* A. Calcium is critial for tertiary hemostasis
  B. Tissue plasminogen activator (tPA) binds to plasminogen within the clot, converting it into plasmin
  C. tPA Release is stimulated by a variety of factors, including hypoxia and bradykinin
  D. Tissue plasminogen activator (tPA) is released from endothelial cells
  E. Plasmin lyses both fibrinogen and fibrin in the clot, releasing fibrin(ogen) degradation products (fdp)

  <img src="Tertiary-Hemostasis.jpg"> Tertiary Hemostasis
At the same time as the coagulation cascade is activated, tissue plasminogen activator (tPA) is released from endothelial cells. tPA Release is stimulated by a variety of factors, including hypoxia and bradykinin. tPA binds to plasminogen within the clot, converting it into plasmin. Plasmin lyses both fibrinogen and fibrin in the clot, releasing fibrin(ogen) degradation products.

38) Prostacyclin and nitric oxide are inhibitors of

  A. Secondary hemostasis
* B. Primary hemostasis
  C. The Common Pathway
  D. Primary and Secondary hemostasis

  <img src="Coagulation-Cascade.jpg">
Naturally occurring inhibitors of platelet function (primary hemostasis) are prostacyclin and nitric oxide, which are released by endothelial cells, and bradykinin.
Platelet function may be inhibited intentionally by the administration of therapeutic agents like aspirin and antagonists of GPIIb/IIIa. is an alpha2-globulin produced in the liver. It inhibits secondary hemostasis by preventing activation of coagulation proteins including factors II, IX, X, XI and XII. Other inhibitors of secondary hemostasis are Heparin (thrombin antagonis), Tissue factor pathway inhibitor and Thrombin.

39) When testing for platelet numbers (primary hemostasis) in dogs or cats, the normal count is

  A. 100,000 /uL or more
  B. 30,000 /uL or more
* C. 200,000 /uL or more
  D. 10,000 /uL or more

  Normal dogs and cats should have platelet counts close to or >200,000/µl. Normal horses and cows should have platelet counts of 100,000/µl or greater. Bleeding, that can attributed solely to thrombocytopenia, does not occur unless platelet counts are < 30,000/µl . <p> Tests for platelet function include measurement of :
Platelet adhesion Platelet aggregation Platelet release reaction.
Virtually all of these tests are only available at specialized veterinary laboratories

  A. Platelet count
  B. Tests for von Willebrand factor (vWf)
* C. Prothrombin Time (PT)
  D. Buccal Mucosa Bleeding Time (BMBT)

  Prothrombin, which is cleaved to create thrombin, in involved in <u>secondary</u> hemostasis. <p>Key tests that are indicative of primary hemostasis function include :
Platelet count and function (adhesion, aggregation and release reaction). von Willebrand factor (vWf) can be quantitively (rocket immunoelectrophoresis or ELISA) or qualitatively (immunoelectrophoresis) measured. Buccal mucosal bleeding time is used as a functional measurement of vWf (Doberman, Shetland Sheepdog, Manchester Terrier and Scottish Terrier often have associated genetic defects). Normal BMBT in dogs is under 4.0 minutes and under 3 minutes in cats Commonly used hemostatic tests include :
ACT Activated clotting time : Uses whole blood. Tests (1) <u>intrinsic</u> pathway (2) thrombocytope (3) presence of inhibitors or anticoagulants APTT: Activated partial thromboplastin time : Uses plasma + activator + phospholipid + Ca++ . Tests <u>intrinsic</u> system (absence o

41) All the following are tests for SECONDARY hemostasis, EXCEPT

  A. Activated Coagulation Time (ACT)
  B. Specific factor assays
* C. Buccal Mucosa Bleeding Time (BMBT)
  D. Fibrinogen tests
  E. Activated partial thromboplastin time (APTT)
  F. Prothrombin Time (PT)

  Buccal mucosal bleeding time (BMBT) is used as a functional measurement of <u>primary</u> hemostasis - specifically vWf (Doberman, Shetland Sheepdog, Manchester Terrier and Scottish Terrier often have associated genetic defects). <p>The key tests for Secondary Hemostasis are :
Activated Coagulation Time (ACT) Activated partial thromboplastin time (APTT) Prothrombin Time (PT) Tests for Fibrinogen Proteins Induced by Vitamin K Antagonism or Absence (PIVKA) Specific factor assay (Clotting Assays, Chromogenic Assays) Some are described <a href="http://www.diaglab.vet.cornel Commonly used hemostatic tests include :
ACT: Activated clotting time : Uses whole blood. Tests (1) <u>intrinsic</u> pathway (2) thrombocytopenia (3) presence of inhibitors or anticoagulants APTT: Activated partial thromboplastin time : Uses plasma + activator + phospholipid + Ca++ . Tests <u>intrins

42) Gray Collie syndrome (Cyclic Hematopoiesis) is characterized by fluctuations in circulating

* A. Neutrophils, reticulocytes, and platelets
  B. T-cells
  C. Red blood cells
  D. B-cells

  Some of the inherited disorders of hemostasis are :
von Willebrand disease. The most common inherited disorder of hemostasis in both human beings and dogs (Doberman, Corgi, Airedale Terrier, Scottish Terrier, and Shetland Sheepdog). <a href="http://en.wikipedia Hematopoiesis of Gray Collies More
Canine/Bovine thrombopathia (platelet function) - seen in Basset hounds & Spitz dogs, Simmental cattle
Inherited deficiencies of the coagulation factors in the coagulation cascade : Deficiencies of intrinsic pathway factors (FXII, FXI, FIX and FVIII) are the most common. Some of these diseases are sex-linked and usually occur in males.

43) Acquired disorders of hemostasis include all of the following, EXCEPT

  A. Disseminated intravascular coagulation
* B. von Willebrand disease
  C. Increased platelet function due to lymphoma
  D. Decreased platelet function due to neoplasia

  von Willebrand disease is the most common inherited disorder of hemostasis in both human beings and dogs (Doberman, Corgi, Airedale Terrier, Scottish Terrier and Shetland Sheepdog). <p>Acquired disorders could result in thrombocytopenia, thrombocytosis, decreased platelet function, increased platelet function and Disseminated intravascular coagulation. <p>Disseminated intravascular coagulation is a pathologic process in which both coagulation and fibrinolysis are inappropriately initiated in the microvasculature, resulting in systemic generation of either thrombin (causes widespread thrombosis) or plasmin (causes fibrinolysis ... hemorrhage).