The Blood

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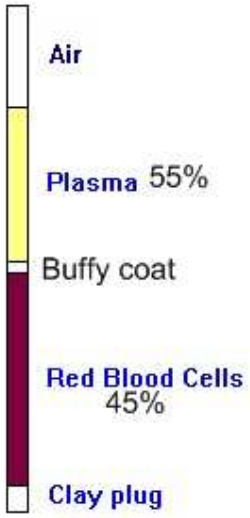
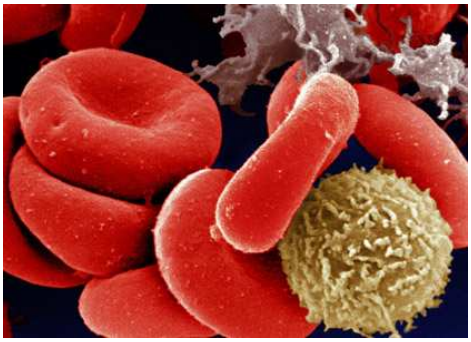
Reading

Blood is **considered** to be a liquid connective tissue. It consists of a non-cellular matrix and a collection of cells (formed elements) that are **suspended** within the matrix. The matrix is called plasma and is **made up of** water, proteins, dissolved gases and other dissolved chemicals such as electrolytes, nutrients, vitamins and hormones. The cellular part of blood can be divided into three categories: (1) red blood cells {RBCs} or erythrocytes, (2) white blood cells {WBCs} or leukocytes and (3) platelets or thrombocytes. The ratio of the plasma to cellular components is about 55% plasma to 45% cells. If a sample of blood is placed in a capillary tube and **spun** in a centrifuge, the plasma and cellular elements distribute themselves as shown in the figure. When the blood is spun the heavier elements are moved to the bottom against the clay plug while the lighter plasma remains at the top. The **buffy** coat consist of white blood cells which are lighter than RBCs and much less numerous.





Reds blood cells are significant, among other reasons, for their ability to carry oxygen from the lungs to the cells that make up the tissues of the body. The oxygen is carried **bound** to a special molecule called hemoglobin. Red blood cells are usually described as biconcave discs. RBCs are among the smallest cells in the body, with only sperm cells being smaller. RBCs are produced in the bone marrow in a process call erythropoiesis. When RBCs enter the circulation they have **lost** their nucleus, which gives them the biconcave depression. Without a nucleus, the cells have a limited **lifespan**. The average RBC only **lasts** for 120 days before it is removed from the circulation by macrophages in the liver.

White blood cells are part of the body's immune system and serve to protect the body from disease. Unlike RBCs, white blood cells do not carry oxygen and they do have a nucleus. There are five subdivisions of WBCs: (1) neutrophils, (2) eiosinophils, (3) basophils, (4) monocytes and (5) lymphocytes. Each subdivision plays a specific **role** in the body's immune response.

The third group of formed elements is the platelets. Platelets play a role in the hemostasis or blood **clotting**. Whenever a blood vessel is breaks something must stop the flow of blood from the vessel. Platelets working in **conjunction** with clotting proteins found in the plasma can block the flow of blood. Platelets are not cells; instead they are fragments of larger cells called megakarocytes. Platelets lack a nucleus and contain few cytoplasmic elements. The lifespan of a platelet is about 9 or 10 days. So like RBCs they need to be produced **continually** and rapidly.

Check Point (1) – Vocabulary

Match the word in Column A with its contextual meaning in Column B.

A	B
1. Bound	A. Accepted to be (true)
2. Clotting	B. Mixed together
3. Conjunction	C. Consists of
4. Considered	D. Rotated
5. Continually	E. Attached
6. Lasts	F. Extruded / removed
7. Lifespan	G. Lives
8. Lost	H. How long something lives
9. Made up of	I. Something's function in a larger more complex activity
10. Role	J. Transition of blood from liquid to solid
11. Spun	K. Working together
12. Suspended	L. To work without stopping

Check Point (2) -- Odd one out

Instructions: Each group of words has one word that does not fit in well with the others. Try to find the odd word.

1	Spin	Rotate	Turn	Twist
2	Clot	Platelet	Neutrophils	Coagulate
3	Eosinophils	Erythrocytes	Basophils	Lymphocytes
4	Tear	Rupture	Cut	Squeeze
5	EDTA	Heparin	Vitamin K	Aspirin
6	Plasma	Blood	Serum	Cerebral Spinal Fluid
7	Ooze	Drip	Gush	Dribble
8	Plug	Block	Occlude	Open
9	Recover	Pull through	Repair	Get better
10	Cluster	Group	Clump	Separate

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Clinical Corner

Anemia: The blood carries a reduced amount of oxygen. This can be caused by reduced number of RBCs or a reduced amount of hemoglobin inside each RBC. (an = without, emia = blood condition)

Anticoagulant: A chemical that can prevent clot formation. Drugs such as heparin and coumdin are used to prevent or reduce clotting in people who have artificial heart valves (which can induce clots) or conditions such vein inflammation. Heparin and EDTA can be added to blood samples to prevent clotting. While calcium celators are added to blood drawn for transfusions to keep it in liquid form until it is used.

Aplastic anemia: A type of anemia that results from the failure of bone marrow to produce RBCs and WBCs.

Bacteriemia: Presence of bacteria in the blood.

Clot: Term used to describe a semisolid mass of cells and proteins that forms to stop bleeding from a broken blood vessel.

Differential WBC count: A measure in which the percentage of each type of WBC is reported. Typical values: neutrophils 40-60%, lymphocytes 20-40%, monocytes 4-8%, eosinophils 1-3%, basophils 0-1%. (phil = love)

Erythrocyte: Scientific name for a red blood cell. (erythro = red, cyte = cell)

Erythropoiesis: Term to describe the process of red blood cell formation in bone marrow.

Erythropoietin: Hormone produced by the kidneys that controls erythropoiesis. People with kidney disease are often anemic because they fail to produce the hormone.

Fibrinogen: A protein produced by the liver that circulates in the plasma as a plasma protein. When fibrinogen encounters activated platelets it attaches and is converted into fibrin as part of the clotting process.

Hematocrit: A commonly measured blood value. The blood is spun in a centrifuge and the ratio of packed RBCs to the total volume is reported as the hematocrit. The abbreviation for hematocrit is Hct. The value is normally reported at a percentage is as Hct = 48%. Normal values: males (38% - 51%), females (36% - 47%). (hemato = blood, crit = to separate)

Hemoglobin: A large 4 part protein combined with 4 molecule containing iron (Fe). The iron can bind reversibly with oxygen. Hemoglobin is intensely colored and is what gives blood its color. Hemoglobin is routinely measure during blood work. Normal values: males (14 – 18 g /dl), females (12 – 16 g / dl). Each red blood cell contains about 300 million molecules of hemoglobin. (hemo = blood)

Hemolytic disease of the newborn: This is an anemia seen in newborns and is usually caused by an incompatible Rh factor between the child's blood and the mother's blood. Antibodies produced by the mother, in response to the child blood, destroy many of the child's RBCs which causes anemia.

Hemophilia: An X-linked genetic condition, seen primarily in males, which prevents normal blood clotting. (philia = to love)

Hemorrhage: The term means to bleed from a broken, cut or ruptured blood vessel. (rrhage = to break)

Hemorrhagic anemia: Reduced oxygen carrying capacity due to loss of blood through bleeding.

Hemostasis: This term refers to the body's ability to stop blood flow from a broken or cut blood vessel. Don't confuse the term with homeostasis. (hemo = blood, stasis = stop)

Leukocyte: Scientific name for a white blood cell. (leuko = white, cyte = cell)

Normochormic: A description of blood that has the normal amount of hemoglobin. A common variation is hypochromic which means blood with less than normal amounts of hemoglobin. (normo = normal, chormic = color, hypo = less / under)

Normocytic: A description of blood that has the normal amount of erythrocytes. (cytic = cells)

Normovolemic: A description of normal blood volume. Variations include hypovolemic / hypovolemia. (volemic = volume)

Packed red blood cells: When whole blood is spun in a centrifuge and the plasma is then removed, the remaining volume is called packed cells or packed red blood cells. When a transfusion is needed, it is sometime preferable to give only RBCs instead of whole blood.

Platelets: These are small cell fragments (without a nucleus) that have the ability to cluster in areas of vessel injuries and create a physical barrier to blood flow through the injured vessel. The also contain chemicals that can initiate blood clotting which involves the conversion of fibrinogen into fibrin.

Polycythemia: A condition in which too many RBCs are produced and the RBC count and hematocrit becomes much higher than normal. Hct can be over 70% and RBC counts can be greater than 8 million cells / mcl. The condition makes the blood very viscous and puts an extra strain on the heart because of the extra resistance to blood flow caused by the increased viscosity. (poly = many, cyth = cells, emia = condition of the blood)

Red blood cell count: A commonly measure blood value which reports the number of erythrocytes per microliter of whole blood volume. Normal values: males (4.7 – 61 million cells / mcl), females (4.2 – 5.4 million cells / mcl). The abbreviation for microliter is mcl or µl.

Reticulocytes: Immature red blood cells that still have their nucleus. Normally reticulocytes extrude their nucleus and become erythrocytes outside the circulation and then the erythrocyte enters the circulation. For this reason, reticulocytes are rarely seen in stained blood smears. However, when erythropoiesis is taking place at an accelerated rate some reticulocytes enter the circulation and extrude their nucleus there. When reticulocytes are seen in the circulation it is a sign of rapid RBC production. (reticulo = network, cyte = cell)

Septicemia: Blood infection caused by a pathogenic bacterium.

Thrombocytes: The term is often used interchangeably with the word platelet – although platelet is becoming the preferred term for humans. In other animals, thrombocytes carry out hemostasis functions, but the cell is nucleated. (thrombo = clump / clot)

Transfusion: The process of taking blood from one person and giving it to someone else. To be successful the blood type of the donor and recipient has to be carefully matched.

White blood cell count: A blood measure which reports the total number of leukocytes. Normal values: 5000 – 10000 cells / mcl.

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Check Point (3) – Prepositions

Complete the sentences below with prepositions from the box. Some prepositions can be used more than once.

to / on / by / inside / from / in / among / below / under / with / at / above / instead of / until / around / underneath / between / in spite of / rather than / in addition to / through / of

1. ____ A+ blood, an A+ person can also receive A-, O+ and O- blood.
2. ____ taking iron tablets, it's better to eat more leafy green vegetables as treatment _____ iron deficiency anemia.
3. ____ the dangers of blood doping, many athletes continue to use the technique.
4. A normal male Hct is ____ 45%.
5. Blood flowing ____ blood vessels does not clot because platelets don't normally interact ____ the normal healthy endothelial lining the ____ blood vessels.
6. For certain blood measures, EDTA is used as an anticoagulant _____ of heparin.
7. Hemoglobin is found _____ erythrocytes.
8. Hemophilia is caused _____ a chromosomal defect.
9. Most blood samples are taken ____ the median cubital vein.
10. People who live ____ high altitudes may have _____ normal hematocrits.
11. Platelets cluster ____ areas where a blood vessel has been damaged.
12. Platelets form a physical barrier ____ blood flow _____ a broken blood vessel.
13. Polycythemia puts an extra strain ____ the heart.
14. Red blood cells are ____ the smallest cells ____ the body.
15. Send the blood sample ____ the lab right away.
16. The lab results will not be back ____ 5 pm tomorrow.
17. When you spin a blood sample, the layer ____ the bottom is the layer of RBCs.
18. When you spin a blood sample, the layer ____ the plasma and the RBCs is the buffy coat.
19. When you spin a blood sample, the layer ____ the plasma is the buffy coat.
20. Women ____ hematocrits _____ 38% may show symptoms of anemia.

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Talking with the Patient

Instructions: work with a partner. One person can read the part of the doctor and the other person can read the part of the patient.

1. D: Good morning Ms. Smith.
2. P: Good morning Doctor.
3. D: How can I help you today?
4. P: Well, I've been feeling really **rundown** lately. I don't seem to have any **stamina** and the littlest things seem to wear me out completely. It seems like I barely have the strength to go to work.
5. D: When did this start?
6. P: I guess it started about two months ago.
7. D: That's quite a while. Did this come on slowly or quickly?
8. P: Well it came on me slowly. At first I thought it was just normal **fatigue** from a busy life. But I never seemed to get stronger – I never seemed to get my energy back, even after a restful weekend.
9. D: Have you had any recent illnesses – anything like a cold or flu?
10. P: No.
11. D: How about allergies – have you had any hay fever?
12. P: No.
13. D: Have you been under any unusual stress lately – problems at work or at home?
14. P: No, everything is about the same.
15. D: Have you started taking any new medications?
16. P: No – nothing new since the last time I saw you – 6 months ago.
17. D: Okay -- well let me do a quick examination – I want to take your temperature, check your blood pressure and listen to your heart and lungs.
18. P: Okay.

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19. D: Well your blood pressure is normal and your **lungs sound clear** and your heart sounds fine.
20. P: What about my temperature?
21. D: Oh, that's fine too.
22. P: So what do you think?
23. D: When I was looking in your throat I noticed that your mucosa and **gums** seem a little **pale**. And the mucosa below your eyes also seems pale.
24. P: What does that mean?
25. D: It likely means that you are anemic – which would explain your fatigue. I'm going to have the nurse take some blood and send it to the lab for a complete **blood work up**.
26. P: How did I become anemic?
27. D: Has there been any change in your periods – has the bleeding been **heavier than normal**?
28. P: No, they seem to be about the same.
29. D: When did you finish your last period?
30. P: About 4 days ago.
31. D: Okay -- Well, sometimes heavier periods can **lead to** anemia – but since you haven't noticed a change, I suspect that your problem is nutrition anemia. So until I get the results of your **blood work**, I going to recommend that you make some dietary changes.
32. P: What kinds of changes?
33. D: Here is a list of foods that are **rich in iron**. I would like for you to try to **incorporate** more of these foods into your daily diet.
34. P: Should I take an **iron supplement**?
35. D: For now – no. After I see the results of your blood work I may change my mind but for now I'm not recommending a supplement.
36. P: Okay.
37. D: I'll have your results back in a couple of days. After I have looked them over I will give you a call. We'll discuss the results and if I need to see you again we'll schedule an appointment.
38. P: Okay.
39. D: If it turns out to be nutritional anemia, I think the change in diet will be all that is needed. And I think you will feel much better in about two weeks.
40. P: Sounds wonderful.
41. D: So if there is nothing else – I'll talk to you in a couple of days.

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42. P: Great, thanks for your time.
43. D: Please give this blood work form to the nurse – she will **draw your blood** and then you will be done.
44. P: I hate giving blood!
45. D: You're not alone.
46. P: I bet – well, see you later.
47. D: No problem.
48. P: Bye.
49. D: Bye – and don't forget to eat lots of leafy greens.
50. P: Okay.

Taking with the Patient

Instructions: Reread the interview and then, working with a partner, try to recreate the interview using some of the question variations below – then switch roles and recreate the interview again using other question variations.

Questions to Remember (note the verb tenses used in the different types of questions)

- ⇨ What seems to be the problem?
- ⇨ How can I help you today?
- ⇨ What brings you in today?
- ⇨ When did the problem start?
- ⇨ Did the problem come on slowly or quickly?
- ⇨ How long have you had this problem?
- ⇨ Has there been any change in your medications since I saw you last?
- ⇨ Are you taking any new medications?
- ⇨ Have you had a recent cold or flu?
- ⇨ Have you had any recent problems with allergies?
- ⇨ Are you allergic to anything?
- ⇨ Have you had any problems with your monthly periods?
- ⇨ Have you had any unusual cramping associated with your periods?
- ⇨ Have your periods been normal?
- ⇨ Have your periods been heavier than normal?
- ⇨ When did you have your last period?
- ⇨ When did you finish your last period?

When did you start your last period?

Talking with the Patient

Instructions: working with a partner, try to recreate the interview. Don't just reread it – try to do the interview using your own question and answer variations while using the same basic case profile.

Instructions: Review the interview and find line numbers that correspond to the interview elements listed below. In some cases different aspects of the same interview element may be addressed in different parts of the interview – one such case has been done as an example. The questions in the table below are not in the sequence of the interview.

Interview element	Line numbers
1. Patient greeting.	
2. Request for information on patients chief complaint	
3. Request for information on patients current and recent health	9, 11 & 29
4. Quick health review with prompts to help patient remember any problems	
5. Request for information about medications being taken by patient	
6. Request for information about changes in stress.	
7. Informing the patient about what is going to happen next in the office visit	
8. Request for information regarding monthly cycle	
9. Explaining the basis for the initial diagnosis	
10. Providing an initial diagnosis	
11. Explaining what additional procedures are needed to confirm the diagnosis	
12. Request for change is diet	
13. Offering an initial prognosis	
14. Recommendations for new diet	
15. Providing patient written information about recommended diet changes	
16. Explaining how lab results will be communicated	
17. Making arrangements for next visit	
18. Concluding the visit	

Comprehension – Discuss the following questions with a partner.

1. What is the patient's chief complaint?
2. Based on the interview, what is the minimum and maximum age you would predict for this patient?
3. When did this patient last see this doctor?
4. How long has the patient been experiencing the chief complaint?
5. Describe the onset of the CC.
6. What is the initial diagnosis?
7. Describe the intended treatment plan.
8. What blood parameters do you think will particularly important?
9. Why is the doctor interested in the patient's monthly cycle?

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Practice Dialog

Instructions: Work with a partner to complete the two scenarios. After completing the first scenario, switch roles and complete the second scenario.

Scenario A:

Doctor -- Initiate a phone conversation with the patient. (1) explain that the blood work confirms nutritional anemia (2) reinforce the need for diet change (3) name some specific foods to include in the diet and recommend a one-a-day vitamin that contains iron (4) reiterate the prognosis (5) tell the patient to call if the prognosis does not evolve as expected (6) conclude the conversation.

Patient – Ask relevant and realistic questions in response to the information the doctor provides.

Scenario B:

Doctor – Initiate a phone conversation with the patient. (1) explain that the blood work did not confirm your initial diagnosis (2) explain that the results are consistent with hemorrhagic and nutritional anemia (3) explain that most likely her periods have been heavier but she didn't recognize it and that is the cause of the problem (4) you want to her come in for some additional tests in the next few days (5) have the patient contact your receptionist to make an appointment (6) reassure the patient that she is in no immediate danger and while her blood value are low, they are not dangerously low (7) respond to any questions (8) conclude the conversation.

Patient – Ask relevant and realistic questions in response to the information the doctor provides.

Asking Questions – Work with a partner to write questions that would generate the listed responses from a patient. Then put the Q and A in what you think is the most logical sequence. Compare your sequence with other groups.

Questions	Responses	Sequence
	At first the bruises where small and would be gone in 4 or 5 days – but they've been getting bigger and lasting longer.	
	I first noticed it about a month ago.	
	I'm 33.	
	I'm married with 2 children – my boy is 2 and my daughter is 4.	
	I've been getting these terrible bruises whenever I bump into something – even little bumps give me a bruise the size of a credit card.	
	Is this going to heart much?	
	m-i-s-h-n-a-r	
	My name is Amanda Mishnar.	
	No, I don't take any medicines.	
	No, I haven't had any illnesses in at least a year.	

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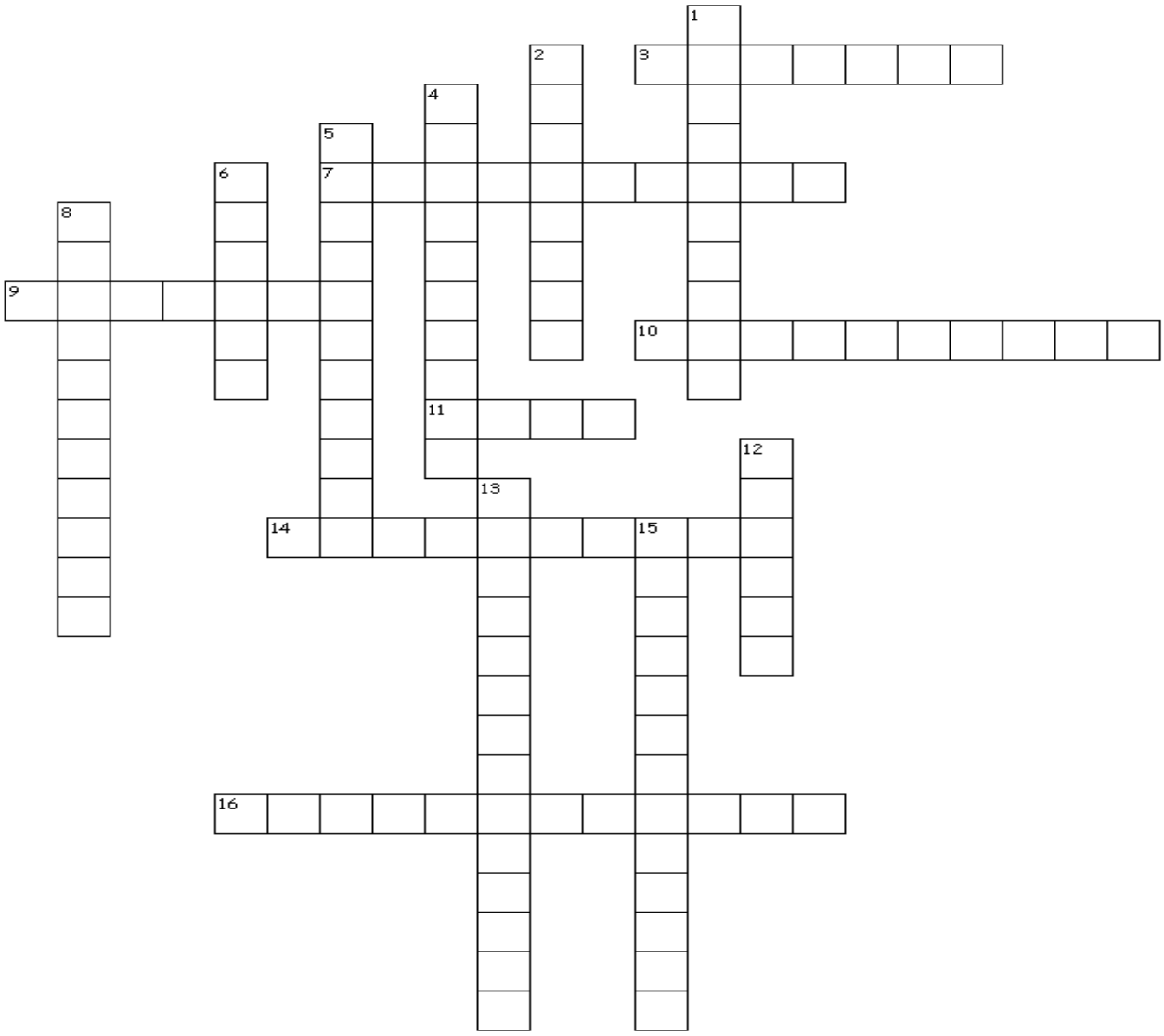
Cross Word Puzzle



Across	Down
3. a common chemical added to vacutainer tubes to prevent clotting of blood samples 7. the percentage of RBCs in a sample of whole blood 9. chemical element essential for blood clotting 10. plasma protein that plays a role in blood clotting 11. metal atom that binds reversibly to oxygen 14. to bleed heavily from a cut vessel 16. someone who specializes in the study of blood	1. most abundant WBC 2. cell fragment that helps start the clotting process. 4. protein molecule found inside RBCs that carries oxygen 5. synonym for platelet 6. another name for hematoma 8. taking blood from one person and giving it to another 12. reduced oxygen carrying capacity of the blood 13. hormone produced by the kidney that regulate red blood cell production 15. chemical substance added to blood to prevent clotting

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Check Point (4) – Vocabulary

Instructions**:** Match the words or phrases in column A with there contextual meaning in column B. All words or phrases in column A can be found in bold print in the Doctor / Patient interview.

A	B
1. rundown	A. A collection of tests preformed on a blood sample
2. no stamina	B. A medicine (sometimes over-the-counter) containing iron
3. fatigue	C. Can cause / can bring about something
4. lungs sound clear	D. Energy level falls quickly
5. gums	E. Light color / lacking normal color intensity
6. pale	F. More bleeding than usual
7. blood work up	G. More iron than in normal foods
8. heavier than normal	H. No abnormal respiratory sounds
9. lead to	I. No energy
10. blood work	J. Blood tests
11. rich in iron	K. Tired / feeling of being tired
12. incorporate	L. Tissue at the margin of the teeth
13. iron supplement	M. To make part of something
14. draw your blood	N. To take blood from a person

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Focus on Blood Types

Instructions: Read the text and fill in the blanks with the missing articles (a / the). Then work with a partner to complete the blood donor / recipient compatibility table.

Red blood cells have over 50 antigens on their membrane surface. Three have special significance and are used to designate ____ person's blood type. ____ three antigens are A, B and D (Rh).

Type A+	Type B+	Type AB+	Type O+
Type A-	Type B-	Type AB-	Type O-

This combination of antigen produces ____ 8 blood types that most people are familiar with. ____ D antigen (Rh) is expressed as (+) if it is present on ____ RBC or as (-) if it is absent. These blood types also determine whose blood a person can receive in ____ blood transfusion. Before ____ transfusion can take place ____ donors blood must be tested against ____ recipient's blood to make sure it is compatible; this process is call ____ "type and cross match." This is necessary because in addition to antigens on ____ surface of RBCs, people also have antibodies in ____ plasma portion of their blood that can react with ____ antigens on RBCs. **It is critical that ____ antibodies in ____ recipient's blood be compatible with ____ antigens on ____ surface of ____ donors RBCs.** ____ antibodies ____ person carries in their blood do not react with their own RBC antigens but can potentially react with antigens from another person's blood if their blood is of ____ different type. ____ table below shows ____ four main blood types and ____ antigens and antibodies present in ____ plasma for each type.

Blood Type	Type A	Type B	Type O	Type AB
Antigen on RBC	Antigen A	Antigen B	No antigens	Antigen A & B
Antibodies present in the plasma	Antibody B	Antibody A	Both Antibody A & Antibody B	Neither Antibody A nor Antibody B

It is worth mentioning at this point that Type O blood means that ____ RBCs have neither antigen A nor B. That is why it is possible for them to have both antibodies. A person with type AB has both ____ A antigen and ____ B antigen in each of their RBCs. For that reason, they cannot have either antibody in their plasma. Normally ____ person who is D- / Rh- does not carry ____ anti-Rh antibody, however, blood is usually typed as if they did. This is done to prevent D- / Rh- people from developing ____ antibody after exposure to D+ / Rh+ blood.

Instructions: Work with a partner and complete the transfusion compatibility table by placing a (✓) in the compatible boxes and an (X) in the incompatible boxes. Several have been done as examples.

		Donor Blood Type							
Recipients Blood Type		A+	A-	B+	B-	AB+	AB-	O+	O-
	A+	✓							
	A-								
	B+			✓	✓				
	B-								
	AB+								
	AB-								
	O+								X
	O-								✓

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The Different Sounds of "G"

Most of the words come from the Clinical Corner section. Pronounce each word and decide what sound the "g" makes. Then write the word in the appropriate box on the right.

Although Anticoagulant Becoming Bleeding Carrying Centrifuge Clotting Containing Cough Drugs During Fibrinogen Fragments Genetic Gives Greater Hemoglobin Hemorrhage Higher Interchangeably Large Oxygen Percentage Remaining Rough Sign Taking Taking Through	"g" has a soft "j" sound
	"g" has a hard sound
	"g+h" is silent
	"g" is not silent and not hard or soft
	"g+h" has an "f" sound

Look back at the words in each box. Do you see a pattern? Check and see if the following rules apply.

⇨ The sound of "g" depends on the letter that following it in a word. If the letter is "e" / "i" / "y" the sound is usually soft. If "g" is followed by any other letter or a space, then the sound is hard. (Note the difference between RAG (a piece of cloth you clean with) and RAGE (to be extremely upset).

- If the desired sound is hard but the following letter would make the sound soft, a "u" is sometimes inserted to prevent the rule from being broken. GUITAR – the "g" has a hard sound, however, if the "u" is removed the "g" would have a soft sound and would sound like JITAR.
- The same effect can be achieved by doubling the "g" and in BIGGER.

⇨ The "g" in words that end in "ing" has a unique sound – neither hard nor soft.

⇨ The "g" in words that have a "g+h" can be silent or have an "f" sound.

- Although = silent "g+h"
- Cough = "g+h" has the "f" sound

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Self Test

Instructions: Take the self-test below and see how well you remember the information presented in this unit.

1. Erythrocytes do not have:
    a. Nuclei
    b. Plasma membranes
    c. Hemoglobin
    d. All the above
2. The element ____ is associated with carrying oxygen and _____ ions are essential for blood clotting.
    a. Iron / calcium
    b. Iron / oxygen
    c. Sodium / calcium
    d. Potassium / iron
3. There are ____ types of leukocytes.
    a. 2
    b. 3
    c. 4
    d. 5
4. Hemophilia is an inherited disease that affects blooding clotting.
    a. True
    b. False
5. Which of the following hematocrit ranges would be considered normal?
    a. 10 – 100%
    b. 10 – 30%
    c. 43 – 46%
    d. 50 – 60%
6. The prefix “leuko” means:
    a. Red
    b. White
    c. Blue
    d. Blood
7. The suffix “phila” means:
    a. To love
    b. To hate
    c. White
    d. Cell
8. Erythropoietin is produced by the:
    a. Liver
    b. Kidney
    c. Spleen
    d. Bone marrow
9. Erythropoiesis takes place in the:
    a. Liver
    b. Kidney
    c. Spleen
    d. Bone marrow
10. The prefix “hemo” means:
    a. Blood
    b. Red
    c. White
    d. Cell
11. The prefix “hypo” means:
    a. Blood
    b. Under
    c. Clump
    d. To separate
12. The condition associated with reduced oxygen carrying ability is called:
    a. Polycythemia
    b. Hemophilia
    c. Anemia
    d. Hemorrhage
13. The layer of white blood cells between the RBCs and the plasma in a spun hematocrit tube is called the:
    a. Leukocyte layer
    b. Buffy coat
    c. Packed cells
    d. Thrombocytes
14. The average lifespan of a RBC is about:
    a. 4 months
    b. 3 weeks
    c. 90 days
    d. 1 year
15. Fibrinogen is a ____ protein produced by the ____:
    a. Blood / spleen
    b. Plasma / liver
    c. Bone / bone marrow
    d. Cellular / platelets

Suggested Mini-Lectures

The mini-lectures listed below can be used as topics for instructors to add additional information to this unit or the topics can be assigned to students for classroom presentations.

- ⇨ Further description of hemoglobin
- ⇨ Further description of the different types of leukocytes
- ⇨ Further description of blood clotting mechanisms
- ⇨ Further description of hematocrit
- ⇨ Further discussion of hemophilia
- ⇨ Further discussion of blood typing

Fun with numbers – Student Activity

Students should practice problem solving language skills whenever possible. The following activities allow students to work in small groups to discuss how to solve related mathematical problems.

1. If the average life span of a RBC is 120 days and a typical blood volume is 5 liters. If a person has a red blood cell count of 5 million cells / mcl, how many red blood cells do they have in their body?
2. For the above person, how many cells must they make per second to keep pace with the rate at which RBCs are dying and being removed from circulation?
3. If the person above has a hemoglobin count of 13 g / dl, how many molecules of hemoglobin are in each of their RBC's?
    a. Molecular weight of hemoglobin = 64,500 g/mol
    b. Avogadro's number = 6.023×10^{23}
4. For the above person, how many molecules of hemoglobin do they have to make per second to match the cell production in question 2?

Key to Check Points and Self Test

Check Point (1)
1. E
2. J
3. K
4. A
5. L
6. G
7. H
8. F
9. C
10. I
11. D
12. B

Check Point (2)
1. twist
2. neutrophil
3. erythrocytes
4. squeeze / cut
5. vitamin K
6. blood
7. gush
8. open
9. repair
10. separate

Check Point (3)
1. instead of (rather than)
2. rather than, for
3. in spite of
4. around
5. through, with, inside
6. instead of
7. in (inside)
8. by
9. from
10. at, above
11. around (in)
12. to, from
13. on
14. among, in
15. to
16. until
17. on (at)
18. between
19. below
20. with, below (under)

Check Point (4)
1. I
2. D
3. K
4. H
5. L
6. E
7. A
8. F
9. C
10. J
11. G
12. M
13. B
14. N

Self Test
1. A
2. A
3. D
4. A
5. C
6. B
7. A
8. B
9. D
10. A
11. B
12. B
13. B
14. A
15. B