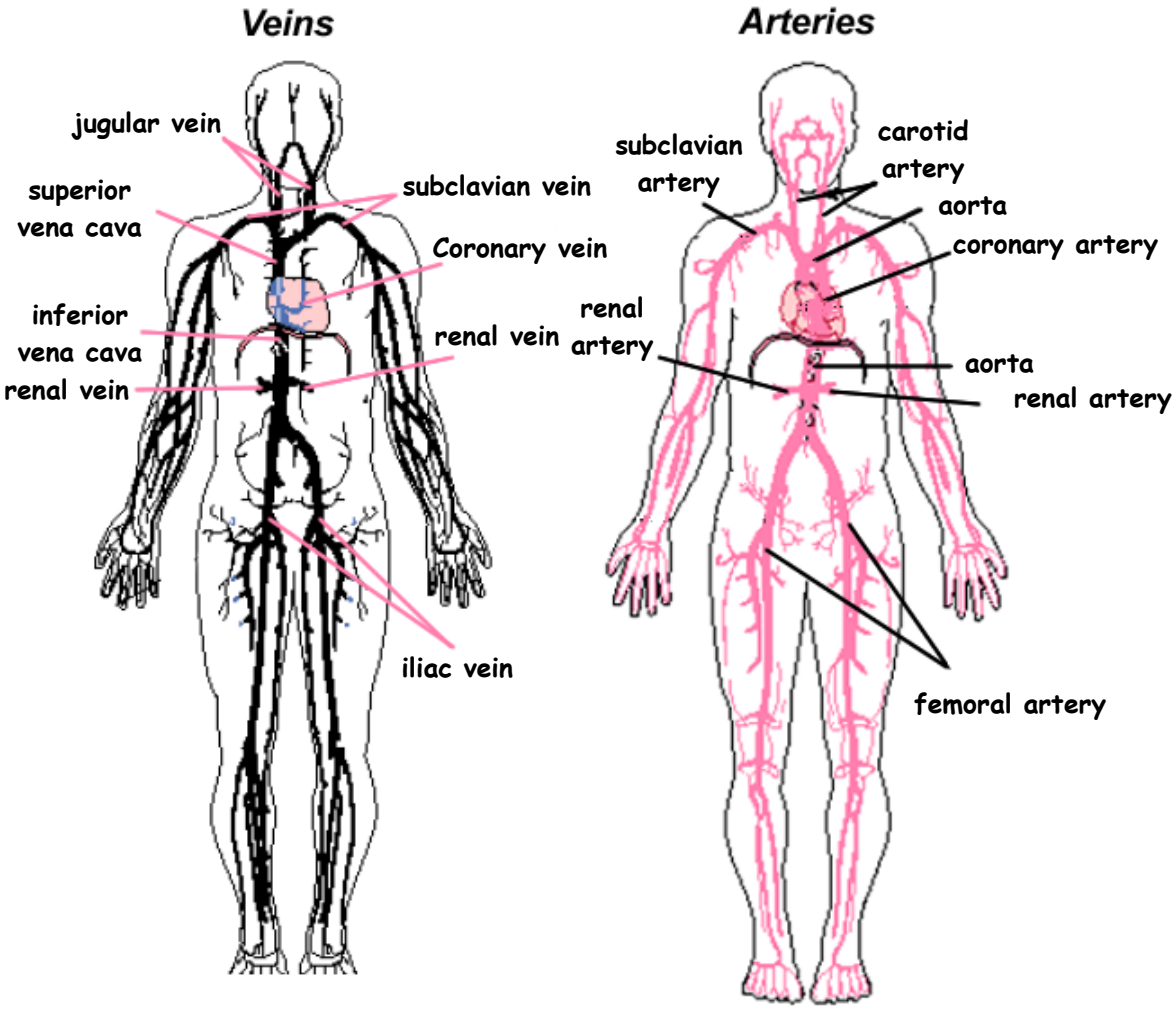
UNIT 6 ANSWER KEY

6.1: PULMONARY AND SYSTEMIC CIRCULATION

1. Label the vessels on the following diagram.



2. The __pulmonary__ circuit carries blood from the heart to the lungs and back whereas the _systemic__ circuit caries blood from the heart to the body and back.

3. =Arteries carry blood _away_ the heart whereas veins carry blood _towards_ the heart.

4. Complete the following table.

Blood Vessel	Carries blood from…	Carries blood to…	Blood is…
aorta	heart	body	oxygenated
superior vena cava	head/upper body	heart	deoxygenated
inferior vena cava	Lower body	Heart/right atrium	deoxygenated

jugular veins	Heart	Head	deoxygenated
subclavian arteries	Heart/aorta	Arms	oxygenated
subclavian veins	Arms	Superior vena cava/heart	deoxygenated
coronary arteries	Heart chanbers	Heart muscle	oxygenated
coronary veins	Heart muscle	Heart chambers	deoxygenated
pulmonary arteries	Heart/right ventricle	lungs	deoxygenated
pulmonary veins	lungs	Heart/left atrium	oxygenated
hepatic artery	Coeliac artery	liver	oxygenated
hepatic vein	liver	Inferior vena cava/heart	deoxygenated
renal arteries	aorta	kidneys	oxygenated
renal veins	kidneys	Inferior vena cava/heart	deoxygenated
hepatic portal vein	Small intestine	liver	oxygenated
mesenteric arteries	aorta	Stomach/intestines	oxygenated
iliac arteries	aorta	Pelvic ragion	oxygenated
iliac veins	Pelvic region	Inferior vena cava/heart	deoxygenated
brachial arteries	subclavian	Lower arm	oxygenated
femoral arteries	Upper body	legs	oxygenated
femoral veins	legs	Upper body/inferior vena cava	deoxygenated

6.2: FETAL CIRCULATION

1. The umbilical vein carries nutrient-rich and _oxygenated_ blood from the maternal system/placenta to the fetal heart.

2. The umbilical artery caries waste and _deoxygenated_ blood from the fetal system to the placenta/maternal system.

3. What features allows:

   a. fetal blood to pass directly from the right atrium to the left atrium?
   = oval opening (ovale foramen)

   b. fetal blood to bypass the lung?
   = arterial duct (ductus arteriosus)

   c. fetal blood to bypass the liver?
   = venous duct

4. What causes a "blue" baby?
   = when oval opening does not close upon birth such that deoxygenated blood from left atrium is mixing with oxygenated blood from right atrium and is subsequently pumped throughout the baby's body giving it a bluish tinge from the poorly oxygenated blood

5. Maternal and fetal blood do not mix, yet waste, nutrients, oxygen, carbon dioxide, drugs and alcohol can all be exchanged between maternal blood and fetal blood. Please identify the structure that facilitates this exchange.
   = placenta

6.3: COMPONENTS OF BLOOD

1. Compare and contrast the structure and function of red blood cells, white blood cells and platelets.

   Red blood cells = biconcave disks lacking a nucleus, transports CO_2 and O_2 bound to hemoglobin

   White blood cells = variable in shape, contain nuclei, help fight off infections

   Platelets = cell fragments that assist in blood clotting

2. Describe the 6 key components of plasma.
   = ~90 % of plasma = water
   = proteins such as albumin for transportation, fibrinogen for clotting and globulins for fighting infections
   = dissolved O_2 and Co_2
   = nutrients such as amino acids, simple sugars, glycerol
   =salts that help regulate osmotic pressure and metabolism
   = cell wastes

3. Red blood cells are truly amazing structures:

   a. Approximately how many RBC are in 1 mm^3 of blood?
   = ~ 5 million

   b. Approximately how long does a RBC live for?
   = ~ 120 days

   c. Approximately how many hemoglobin molecules are found within a single RBC?
   = ~ 200 000 000

   d. What is the function of hemoglobin molecules?
   = to transport O_2 and CO_2 and to bind excess hydrogen ions so that the pH of blood remains relatively constant

4. Briefly describe the process of clotting.
   = injury leads to prothrombin being converted to active thrombin via the protein, thrombolplastin
   = thrombin then converts inactive fibrinogen to active fibrin
   = Fibrin forms a lattice network that traps blood cells such that they form a temporary fibrin clot
   = once vessel repair occurs, plasmin destroys the fibrin clot

5. A person who is blood Type A will have Antigen _A_ on his/her RBCs' and make antibodies against Antigen _B_.

6. People who are Blood Type O are considered "universal _donors_" as they _lack_ any antigens on their RBCs and thus, their blood does not cause another person's immune system to respond.

7. People who are blood Type AB is considered "universal _recipients_" as they have both _A_ and _B_ antigens on their RBCs and thus, their immune systems will not attack any other blood that contains these antigens.

8. If an Rh- mother has an Rh+ fetus (may only occur if father is Rh+) then the mother may produce antibodies against the fetal blood and this could cause _agglutination_ (clumping) of the blood which is potential dangerous to the fetus.

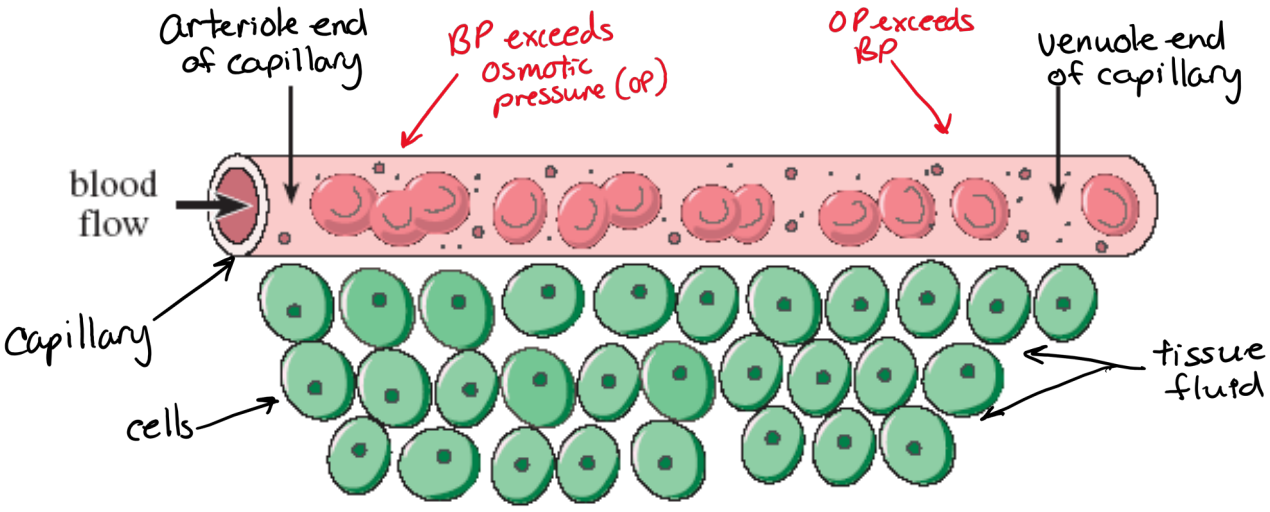
6.4: LYMPHATIC SYSTEM

1. Describe four main functions of the lymphatic system.
= recover excess fluids from tissues to return to circulatory system
= absorption of the glycerol and fatty acids of lipids from lacteals in villi of the small intestine
= produce lymphocytes (B and T cells of the immune system)
= filter and trap bacteria

2. Give a function for each part of the lymphatic system listed below.
- **a.** lymph capillaries = absorb excess fluids from tissues
- **b.** lymph veins = carries fluid from lymph capillaries to circulatory system
- **c.** lacteals = absorb products of fat digestion
- **d.** lymph nodes = filter pathogens such as bacteria from fluids and produce lymphocytes
- **e.** valves = prevent fluid within lymph vessels from flowing back towards the feet

6.5: CAPILLARY TISSUE FLUID EXCHANGE

1. The diagram below represents a capillary and surrounding tissue cells:
   - **a.** Label the arteriole end of capillary, the capillary, the cells, the tissue fluid, and the venule end of the capillary on the diagram below.
   - **b.** Indicate the side of the capillary bed where blood pressure exceeds osmotic pressure and the side where osmotic pressure exceeds blood pressure.



c. Explain how the conditions inside the capillary bed allow for the exchange of nutrients and wastes between the capillary and the tissue fluid.

= high blood pressure at arteriole end helps force nutrients out while lower blood pressure at venule end enables uptake of waste
= vessels being 1 cell layer thick enables diffusion across vessel walls
= slower blood velocity affords substances time to diffuse across cell walls
= high surface area to volume ratio of capillaries enables more efficient diffusion

2. At which location in the circulatory system is blood velocity the slowest? You may wish to refer back to Lesson 1 of this unit. Please explain why this situation is beneficial to us. In your opinion, are the capillary beds the most important part of the circulatory system? Explain

= capillaries

= slower blood velocity affords substances time to diffuse across cell walls

= arteries and veins essentially exist to service capillaries, in other words to bring blood to the capillaries so nutrient and waste exchange can occur with tissue cells, without capillaries our cells would not be able to get nutrients or get rid of waste yet without arteries and veins we would not be able to transport these nutrients to and wastes from capillaries so it is best argued that all are extremely important to the circulatory system and a properly functioning human body

6.6: INTRODUCTION HEART

1. Complete the following table.

HEART STRUCTUE	DESCRIPTION	FUNCTION
right atrium	top right chamber	collects deoxygenated blood from body
left atrium	Top left chamber	Collects oxygenated blood from lungs
right ventricle	Bottom right chamber	Pumps deoxygenated blood to lungs
left ventricle	Bottom left chamber	Pumps oxygenated blood to body
coronary arteries	On/in cardiac muscle	Supplies oxygenated blood to cardiac muscle
coronary veins	On/in cardiac muscle	Removes deoxygenated blood from cardiac muscle
superior vena cava	From upper body, enters right atrium	Collects deoxygenated blood from upper body and delivers to right atrium
inferior vena cava	From lower body, enters right atrium	Collects deoxygenated blood from lower body and delivers to right atrium

pulmonary vein	Exits lung to left atrium	Carries oxygenated blood from lung to left atrium
pulmonary artery	Exits right ventricle to lungs	Carries deoxygenated blood from right ventricle to lungs
aorta	Exits left ventricle to body	Carries oxygenated blood from left ventricle to body
atrioventricular valves	Between atria and ventricles (aka AV valves)	Prevents backflow of blood from ventricles to atria when ventricle contract
chordae tendineae	Attached to AV valves	Ensues AV valves remain closed when ventricle contract
semi-lunar valves	In aorta and pulmonary artery	Prevent backflow of blood from aorta and pulmonary artery into ventricles due to gravity
septum	Between left and right chambers	Prevents

6.7: THE HEART

1. Compare and contrast the terms systole and diastole:

   a. in relation to the heart itself

   systole = contraction of cardiac muscle…either of atria or ventricles

   diastole = relaxation of cardiac muscle…either of atria or ventricles

   b. in relation to blood pressure readings.

   systole = in blood pressure readings refers to the pressure that results specifically from contraction of the ventricles (represents the higher blood pressure number listed on top of the reading…for example 120/80 mm Hg means the systolic pressure is 120 mm Hg)

   diastole = in blood pressure readings refers to the pressure that results specifically from relaxation of the ventricles (represents the lower blood pressure number listed on bottom of the reading…for example 120/80 mm Hg means the diastolic pressure is 80 mm Hg)

2. The "lub-dub" sound of the heart is caused by the _AV Valves_ closing and then the _semilunar valves_ closing.

3. Describe the nodal tissue of the heart including what it is, where it is found and what it does.

   = combination of nerve and muscle tissue within the right atria of the heart

   = controls the heart beat…the sinoatrial node (SA) in the top right of the right atrium is called the pacemaker and initiates atrial contraction (from the top of the atria downwards) approximately every 0.8 seconds whereas the Atrioventricular node (AV node) is near the bottom left of the right atrium and collects the electrical signal to pass on to the AV bundle (bundle of His) to the

purkinje fibers found in the walls of the ventricles so that ventricle contraction can be initiated from the bottom of the ventricles upwards.

4. Explain the difference between intrinsic and extrinsic control of the heart beat and briefly explain how each is achieved.

Intrinsic control = regulation of the heart beat by nodal tissue within the heart itself, this is regulated by the sinoatrial node which initiates atrial contraction approximately every 0.8 seconds, atrial contraction then triggers ventricle contraction via the AV node → bundle of His → Purkinje fibres

Extrinsic control = regulation of the heart beat by the brain, this is regulated when the cardiac centre of the medulla oblongata either triggers the parasympathetic system to release acetylcholine from the Vagus nerve and thus, slow the signals from the SA and AV nodes (decreasing heart rate) or triggers the sympathetic system to release norepinephrine from the accelerator nerve and thus, speed up the signals from the SA and AV node (increasing heart rate). Whether the parasympathetic or sympathetic response is triggered depends on blood pressure and CO_2, O_2 and H^+ levels in the blood.

5. Maintaining appropriate blood pressure in necessary to good health:

a. What is considered "normal" blood pressure for an adult human?
= 120/80 mm Hg

b. Define hypotension and its possible drawbacks.
= low blood pressure (below 90/60 mm Hg)
= dizziness, fainting, difficulty concentratin, blurred vision, nausea, fatigue, depression, thirst
= may indicate improper heart beat or dehydration

c. Define hypertension and identify some possible causes.
=high blood pressure (below140/100 mm Hg)
= high salt diet leading to water retention in blood, presence of plaques in arteries causing narrowing of the artery