Anatomy & Physiology 2 Mazes

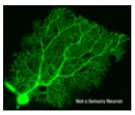
MEDscience Physiology Maze Collection is Free as is Bio101 Pak

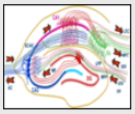
If new to physiology, FIRST try our free MEDscience Physiology Pak - for students thinking about PreMed and Health Sciences. THEN try A&P II to test your *Organ System Physiology* chops: Respiratory, Digestive System, Renal, Metabolism, Cardiovascular, Endocrine and Neural Physiology. Nice aid for tutors, MCAT prep and MOOCs!

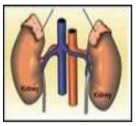
Make sure to use the TIPS! - and if sent back to a question you probably got it right the first time: *try it again* and it may turn GREEN!

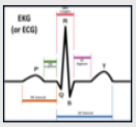
Collapse all

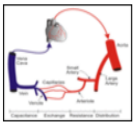
Biology - Anatomy & Physiology 2 — **10 MAZE COLLECTION = $2.99** Purchased

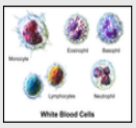
1. 
   Anatomy & Physiology 2.1 Neurons & Sensory Systems
   First Maze in the A&P II Semester Pak (which builds upon the free MEDscience Physiology Pak). This maze game on Systems Physiology introduces some neuronal basics and the operation of sensory systems.

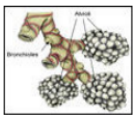
2. 
   Anatomy & Physiology 2.2 - Systems Neuroscience
   A&P 2.2 completes a very brief introduction to neurobiology. Type *neuro* in the Search Box, or scan the BIOLOGY TAB for more neurobiology maze games.

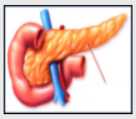
3. 
   Anatomy & Physiology 2.3 - ANS / Endocrine System
   This Maze spans autonomic and endocrine functions, including insulin, nerve agent, thrxine & more. Can try MEDscience Endocrine first--a bit easier.

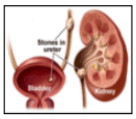
4. 
   Anatomy & Physiology 2.4 - The Heart
   The first of two cardiovascular mazes, this one focuses on the structure and function of the heart.

5. 
   Anatomy & Physiology 2.5 - The Circulatory System
   Review / Learn about types of blood cells, vessels and capillary dynamics and how they are regulated by CNS, lungs and kidneys.
   ⭐ You completed this maze on Dec 23, 2015 - 08:03 PM

6. 
   Anatomy & Physiology 2.6 - Immunology & Lymphatics
   Focus is on Innate & Adaptive Immunity, as well as Lymphatic Tissue. T cells and B cells and Nodes, oh my! For an easier immuno maze try: MEDscience06

7. 
   Anatomy & Physiology 2.7 - The Respiratory System
   This maze covers the physiology of the lungs as well as blood gasses and neural control of breathing. For Respiratory Basics try MEDscience 02 maze game.

8. 
   Anatomy & Physiology 2.8 - The Digestive System
   The GI system: know it from beginning to end! Includes transport, peristalsis, bile, regulation & more.

9. 
   Anatomy & Physiology 2.9 - The Kidneys
   This A&P II game takes you from Bowman's capsule, through the nephron and on down to the bladder and tests water and pH balance.

10. 
    Anatomy & Physiology 2.10 - Energy & Homeostasis
    Metabolism & Balance samples such topics as fluids, temperature, pH, homeostasis, nutrition & bioenergetics. Complementary maze games include Nutrition101 and Bio101.7-Bioenergetics.

Anatomy & Physiology 2.5 - The Circulatory System

Please email contact@mazefire.com for corrections / technical issues. MEDscience Physiology has other mazes in this area.

Collapse all

Q1. Which of the following is NOT a specific function of the circulatory system?

A. move blood throughout the body (with the heart's help)
B. exchange nutrients and waste products between blood and tissues
C. transport hormones, immune cells, nutrients, wastes, and gasses
D. regulate glucose levels
E. regulate blood pressure

The heart would not be of much use without a circulatory system to deliver nutrients throughout the body and remove wastes. The circulation most obviously collects oxygen from the lungs and returns a waste product, carbon dioxide, to be exhaled. Most nutrients come from the GI system, while different byproducts of metabolism are delivered back to the GI system or excreted by the kidneys. Hormones are not only circulated by the vasculature, but some directly regulate it, working in conjunction with glands and the CNS to maintain blood volume and pressure. Important sensors are found at different locations in the circulatory

Q2. The set of blood vessels that supplies blood to all parts of the body except the lungs is called the:

A. systemic circulation
B. pulmonary circulation
C. coronary circulation
D. portal circulation
E. venous circulation

INCORRECT responses shown in **RED**
CORRECT responses shown in **GREEN**

Blood exiting the left ventricle through the aorta is distributed to all parts of the body via the systemic circulation, with one exception: the lungs are supplied by the pulmonary circulation, which is supplied deoxygenated blood via the right heart. Because the heart muscle is think (especially the left ventricle), it needs its own supply of blood, which comes from two small branches (aka coronary arteries) at the base of the aorta. When someone says "don't have a coronary", they mean "do not spaz out these arteries". If we'd asked about the vessels that RETURN blood to the heart, that would be the venous system.

Q3. Which statement concerning the fluid flow equation (flow = pressure drop/resistance) is INCORRECT?

A. the pressure drop term concerns the pressure difference between 2 points
B. with zero pressure, some fluid can still flow as long as there is an opening
C. resistance is largely determined by the diameter of the blood vessel
D. regulation of vessel diameter occurs throughout the circulatory system
E. the viscosity of fluids can affect their flow rate

Answer (B) sounds good, but the flow equation is a physical law: no delta-P (pressure drop), means no blood flow. In other words, if there was an opening, blood would only flow that way if the pressure past the opening was lower: fluids flow only in the context of a pressure drop. Diameter, of course, has to be important, since flow stops when diameter goes to zero (i.e. resistance to infinity). In fact resistance scales with the fourth power of 1/radius, so narrowing an arteriole or precapillary sphincter by half, will cut flow to 1/16th. Many endocrine, neural and autoregulatory mechanisms rely on this relationship to regulate both local and systemic blood flow. Viscous fluids, like lava, flow more slowly of course, but this does comport with the flow law, since at such low flow rates, the pressure drop is very small and the resistance high. Hint: think about what is outside the opening.

Q4. Which of the following would NOT promote a LOCALIZED change in blood flow?

A. release of nitric oxide
B. release of atrial natriuretic peptide (or factor)
C. increased tissue oxygen consumption
D. increased tissue CO_2 production
E. release of metabolic byproducts such as lactic acid

Atrial natriuretic factor is a circulating hormone released by the heart (in response to low blood volume) and so would not have localized effects. When specific muscles or brain regions are quite active they consume more oxygen and produce more CO_2 and waste products. These are signals that prompt local mechanisms of increasing blood flow, including nitric oxide production, by e.g. dilating arterioles. This is an elegant mechanism for bringing more nutrients into the area and quickly washing away waste products, especially since the response fades when it is no longer needed.

Q5. Baroreceptors in the circulatory system

A. are found mainly in the atria and ventricles
B. are sensitive to atmospheric pressure
C. relay pressure signals directly to the SA and AV nodes
D. can distinguish turbulent from laminar flow
E. inhibit cardiac output when they are stimulated

The most prominent baroreceptors are found in the aorta and carotid arteries, although volume receptors are found in the atria. While the baroreceptors can signal increases in blood pressure (BP), their more important role is to say HEY, blood flow to the body and the BRAIN have been compromised! They can quickly signal a fall in blood pressure because they continuously fire at a modest rate, and any drop in firing rate is immediately detected in the brainstem (which is where their axons project). This triggers compensatory mechanisms to restore BP to normal. Conversely, if blood pressure abruptly rises (and there is no emergency, e.g. a tiger next to you), the CNS cardiac centers say, HEY mellow out (or more precisely they say: lower Heart Rate and Stroke Volume). This decreases cardiac output and causes BP to drop. Over the longer term, they tend to desensitize to chronic hypertension and so are not much help with that. There is no evidence they can distinguish fluid flow regimes or that they respond to changes in atmospheric pressure!

Q6. A fall in blood pressure would most likely result from

A. activation of the sympathetic nervous system
B. activation of the parasympathetic nervous system
C. release of the enzyme renin
D. release of the hormone aldosterone
E. release of the hormone ADH

Every answer but (B) helps to increase BP or blood volume. Parasympathetic activity slows the heart rate which can decrease blood pressure, since BP depends upon cardiac output. Sympathetic activation increases heart rate AND cardiac contractility, both of which can help to increase or restore BP. If blood flood volume and BP drops, the kidneys release renin which leads to Angiotensin II activity and intense vasoconstriction, which works with the sympathetic and adrenal systems to restore BP or provide necessary cardiac output.

Q7. For an average person, the hydrostatic pressure in the pulmonary circulation is likely to be in the neighborhood of

A. 120/80 mmHg
B. 60/40 mmHg
C. 25/15 mmHg
D. 5/2 mmHg
E. because of its low resistance, pulmonary circulation pressures are usually negligible

Pressures in the pulmonary circulation are roughly 1/5th of the systemic circulation, i.e. ballpark 25/15 mm Hg. These pressures CANNOT be negligible because fluid will flow only as a consequence of pressure gradients. It is not a trivial thing to measure pulmonary pressures, in contrast to systemic pressures which are easily monitored with a pressure cuff. In congestive heart failure, the left heart is less able to pump blood into the general circulation, which makes it difficult to move any blood entering the lungs along, given that they are the low pressure side of the circulatory system. This can lead to fluid build up in the lungs.

Q8. Which is not a type of blood vessel?

A. central canal
B. capillary
C. venule
D. arteriole
E. portal circulation

The central canal is part of a different fluid system in the body, the CSF or cerebrospinal fluid. It runs the length of the spinal cord and connects with the ventricular system of the brain. Venules and arterioles are small veins and arteries respectively and connect capillaries to those systems. Portal circulations are specialized blood pathways that connect two organs. For example, nutrients absorbed in the GI system are routed directly to the liver's blood supply, while hypothalamic releasing factors are secreted into a portal circulation that flows though the pituitary gland. More on this in other mazes in this collection.

Q9. The blood vessel that exits the left ventricle is called

A. the pulmonary artery
B. the aorta
C. the inferior vena cava
D. the superior vena cava
E. the femoral artery

The aorta is the strongest blood vessel in the body, accepting the highest pressure blood in the body, that emanating from the left ventricle. As it branches, it sends blood vessels to all parts of the body, including 3 major blood vessels running up (towards the head), coming off the aortic arch. The aorta then runs down into the abdominal cavity and divides into smaller branches.

Q10. Reabsorption of fluid along the venous side of a capillary bed occurs because:

A. the hydrostatic pressure of the blood falls significantly from the arterial to the venous end
B. there is a relatively constant osmotic pressure along the capillary bed that tends to pull fluid into capillaries
C. the interstitial fluid has a very high concentration of proteins
D. ALL of the above are correct
E. only (A) and (B) are correct

Blood pressure falls along the course of most capillary beds from about 35 mm Hg at the arteriole input side, down to 17 mm Hg where it empties into a venule. Capillary fenestrations and gaps between endothelial cells enable water and nutrients to move out of the capillaries and into the ISF (interstitial fluid aka extracellular space). But in order that all of our blood plasma does not end up in tissues, the great bulk of that fluid must be reabsorbed, and it IS by the time the blood reaches the venule side. Even at 17 mm Hg, capillary fluid pressure is greater than ISF, but this is countered by osmotic pressure: the capillary has a high concentration of protein whereas ISF has very little. This results in an osmotic pressure that pulls fluid back into the capillary and thus maintains fluid balance. The swelling tha after an injury is a consequence of an imbalance.

Q11. Blood cells, including all types, can be formed in which of the following tissues?

A. bone marrow
B. lymphoid tissue
C. the liver
D. the yolk sac
E. ALL of the above

Red and White blood cells are produced throughout life from hematopoietic stem cells. These cells originate in the yolk sac of the embryo and migrate to the liver, where they proliferate during fetal development. After birth, stem cells migrate to the bone marrow which produces many types of blood cells including cells that migrate to lymphoid tissue (lymph nodes, etc.) and give rise to lymphocytes. In certain cancers, the bone marrow cells are killed off to get rid of the cancer, after which a bone marrow transplant (usually from a compatible donor) is given to restore the RBC and immune systems. Hint: this question applies to all types of blood cells at all ages.

Q12. This gland releases cortisol, aldosterone and epinephrine to deal with stress and blood pressure/volume issues.

A. the adrenal gland
B. the renal gland
C. the pituitary gland
D. the pineal gland
E. the thymus

If you googled epinephrine, you'd find that it is also called adrenaline (depending upon whether your Brit or Yankee). Adrenal means above the renal, but there is no such thing as renal gland: the adrenal sits atop the kidneys. The adrenal cortex makes the steroid hormones cortisol (released in response to stress, missing in Addison's disease) and aldosterone, which regulates blood volume (more on that in renal physiology maze). The adrenal medulla releases adrenaline aka adrenalin aka epinephrine (what's WRONG with scientists?). The body is at least smart and releases this powerful energizer hormone in times when vasoconstriction and increased cardiac output are needed. The pituitary secretes ACTH (and MANY other hormones) to regulate cortisol production, while the sympathetic nervous system releases norepinephrine and works hand in hand with the adrenal gland. Pretty much no one cares about the pineal or thymus. Just kidding. Sorta.

Q13. To initiate the production of the powerful vasoconstrictor Angiotensin II, a fall in blood pressure is sensed in

A. the liver
B. the right atrium
C. the lungs
D. the kidneys
E. the aortic and carotid bodies

Nothing gets the body's attention like a rapid drop in blood pressure aka hemorrhage (e.g.). Baroreceptors (in the A&C bodies) trigger the fastest response which is mediated by the sympathetic nervous system which fires up the heart, vasoconstriction and the adrenal gland. In parallel, a specialized structure in the kidney vasculature/filtration system called the juxtaglomerular apparatus (JGA) senses reduced flow or pressure and releases the enzyme renin, which acts like a hormone, sorta. It cleaves circulating angiotensinogen (produced by the liver) creating the 10 amino acid prohormone, Angiotensin I. In the lungs, the enzyme ACE removes 2 amino acids from A I, creating Angiotensin II, a powerful constrictor of arterioles and precapillary sphincters. Blood building up behind this vasoconstriction increases available blood volume and blood pressure, although the CV system must selectively allow blood flow to continue to the heart and brain, while the crisis is being dealt with. Chronically, ACE inhibitors are used to reduce AII levels and vasoconstriction. What condition would they be used for?

Q14. Which of the following is the most direct and immediate cause of circulatory collapse?

A. decreased tissue perfusion
B. massive activation of the vasomotor center
C. increases in heart rate
D. disruption of thought processes
E. intense smooth muscle vasoconstriction

Circulatory collapse is the end stage of shock and is generally irreversible. Signs of a person going into shock should be treated with extreme urgency. These signs include low blood pressure (weak pulse), fast heart-rate, confusion and unconsciousness. Circulatory collapse occurs when the body's efforts to restore blood pressure and blood flow are ineffective. At this point, key organs of the body are no longer being perfused (i.e. blood flow had declined or halted). This can result in paradoxical vasodilation, because mechanisms of vasoconstriction are lost. Once system wide vasodilation ensues the condition is irreversible, to our best understanding.

Q15. Which of the following most directly enhance cardiac contractility?

A. the vagus nerve
B. parasympathetic nerve fibers entering the SA node
C. sympathetic nerve fibers entering the SA node
D. sympathetic nerve fibers entering the ventricular myocardium
E. vasomotor fibers innervating the coronary arteries

Cardiac contractility refers to the force exerted by heart muscle on blood in its chambers. This can be increased by boosting the calcium influx into cardiac muscle cells, thus increasing the force that the heart generates. While some circulating hormones can boost contractility (notably epinephrine), the sympathetic nervous system also helps by releasing norepinephrine in cardiac muscle. The parasympathetic nervous system (e.g. vagus nerve) tends to oppose or blunt these effects. Actions on the SA note mainly affect heart rate, but together these two mechanisms can strongly boost cardiac output by boosting stroke volume AND heart rate.

Q16. Another *name* for Red Blood Cells (RBCs) is

A. erythrocytes
B. leukocytes
C. platelets
D. neutrophils
E. biconcave discs packed with hemoglobin that squeeze through capillaries

Erythrocytes (in mammals) are essentially bags of hemoglobin, with a flexible peri-membrane skeleton and a carbon dioxide transporter (technically an HCO3-/Cl- antiporter: more in respiratory physiology maze). White blood cells aka leukocytes are a heterogeneous class including lymphocytes, neutrophils, eosinophils and more. Platelets are also called thrombocytes and contribute to thrombosis (blood clotting) which is normally good but can kill you. Answer E is a nice description, but it is totally NOT a name!

Q17. Which is NOT an aid in the return of venous blood to the heart?

A. the use of one-way valves in e.g. veins in the legs
B. a mechanical pumping effect of the leg muscles
C. mechanical effects of the diaphragm
D. distensibility (compliance) of larger veins
E. ALL of the above DO in fact aid the return of venous blood to the heart

Once blood has exited capillary beds into the venous side of the systemic circulation, blood pressure is below 15 mm Hg, which limits the ability of BP alone to return blood to the heart--which is the lifeblood of our bodies, both figuratively and literally! The biggest challenge is getting blood from the feet to the heart when standing. Fortunately, veins are positioned such that leg muscle contractions squeeze them, pushing blood upwards in the veins. But this only works because of a series of one-way valves, very much like locks in a canal system: once the blood moves up a station, it can wait until the next contraction moves it forward. The diaphragm does a related thing with its bellows like movements. Lastly, the large veins of the abdomen can easily expand to accommodate the incoming blood and route it to the right atrium.

Q18. In the pulmonary circulation

A. arteries carry oxygenated blood, veins carry deoxygenated
B. veins carry oxygenated blood, arteries carry deoxygenated
C. veins and arteries carry oxygenated blood
D. veins and arteries carry deoxygenated blood
E. only the capillaries have oxygen

The pulmonary circulation is the opposite of the systemic circulation, because it has the opposite job. All of the oxygen poor blood of the systemic arteries flows to the right atrium, and the right ventricle pushes this deoxygenated blood into the pulmonary artery. The pulmonary artery perfuses this blood through the capillaries of the lungs in the hopes that you are still breathing and can load it with oxygen. This works so well that the venous blood leaving the lungs is nearly saturated with oxygen (i.e. carrying all the oxygen that it can). This "venous" blood then becomes "arterial" blood when it passes through the left heart.

Q19. Vasoconstriction

A. is the body's response to chronic high blood pressure
B. is necessary to squeeze blood through capillaries
C. refers to the physiological narrowing of blood vessels
D. refers to the pathological narrowing of blood vessels
E. is another name for vasodilation

Vasodilation (widening) and vasoconstriction (narrowing) are the two physiological means of regulating vessel diameter and therefore blood flow. It seems like squeezing harder (constricting) should push more fluid through, but in the context of the arterial system if you narrow one branch, the blood will just go to other branches. If you want to increase flow to an organ or muscle, you need to dilate its incoming arterioles and precapillary sphincters so that blood can flow through more easily. At the system level, hormones and the sympathetic nervous system can promote widespread vasoconstriction which will (at least temporarily) increase blood pressure. This is done e.g. during a hemorrhage so that blood flow can be diverted to the most crucial of organs, the heart and brain.